# Arsenic Removal from Drinking Water by Coagulation/Filtration U.S. EPA Demonstration Project at Town of Arnaudville, LA Final Performance Evaluation Report

by

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> Contract No. 68-C-00-185 Task Order No. 0029

> > for

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Sally Gutierrez, Director National Risk Management Research Laboratory

#### **ABSTRACT**

This report documents the activities performed during and the results obtained from the arsenic removal treatment technology demonstration project at the United Water Systems' facility in Arnaudville, LA. The objectives of the project were to evaluate: (1) the effectiveness of Kinetico's FM-284-AS pressure filtration system using Macrolite® media in removing arsenic to meet the maximum contaminant level (MCL) of  $10~\mu g/L$ , (2) the reliability of the treatment system for use at small water facilities, (3) the required system operation and maintenance (O&M) and operator skill levels, and (4) the capital and O&M cost of the technology. The project also characterized water in the distribution system and residuals generated by the treatment process. The types of data collected included system operation, water quality, process residuals, and capital and O&M cost.

Upon approval of the engineering plan by the Louisiana Department of Health and Hospitals (LADHH), the treatment system was installed and became operational on June 23, 2006. The system consisted of a 5,000-gal contact tank (converted from a pre-existing aeralater) and two 84-in × 96-in steel pressure tanks configured in parallel. Each pressure tank was loaded with 75 ft<sup>3</sup> of Macrolite® media, a spherical, low density, and chemically inert ceramic media, to which filtration rates up to 10 gpm/ft<sup>2</sup> (at a design flowrate of 770 gal/min [gpm]) might be applied (the actual flowrate was 335 gpm [on average]). Due to the presence of ammonia (1.9 mg/L [as N]) and total organic carbon (TOC) (1.3 mg/L) in source water, potassium permanganate (KMnO<sub>4</sub>) was selected as the oxidant to oxidize As(III) (24.4  $\mu$ g/L [on average]) and Fe(II) (1,906  $\mu$ g/L [on average]). After arsenic-laden iron solids had been removed by the pressure filters, the treated water was softened, with 30% bypass, and chlorinated before entering the distribution system.

Source water was supplied by two 10-in production wells, i.e., Wells No. 1 and No. 2, at 350 and 375 gpm, respectively. Quality of well water from both wells was similar, containing 24.1 to 43.0  $\mu$ g/L of arsenic (existing mostly as soluble As[III]), 1,477 to >3,000  $\mu$ g/L of iron (existing almost entirely in the soluble form), and 96.2 to 196  $\mu$ g/L of manganese (also existing almost entirely in the soluble form).

Because the aeralater was used not only as a contact tank, but also for aeration (although unintentionally), a number of operational and performance issues occurred during the performance evaluation study. After approximately five months into system operation, extensive biofouling became evident, causing the filters to be backwashed up to eight times per day (from one to two times per day after system startup). Aeration in the aeralater, with an average dissolved oxygen (DO) level of 5.5 mg/L, apparently had caused biological activities, including nitrification, to occur. To curb continuing biological activities in the filters, several actions were taken, including performing a hydrochloric acid (HCl)/caustic wash of the filter media, replacing KMnO<sub>4</sub> with gas chlorine, and turning off the blower of the aeralator. Due to the presence of elevated soluble As(V) in the filter influent/effluent, a system modification application package was prepared and submitted to LADHH for supplemental iron addition. While the benefit of supplemental iron usage was inconclusive, extra solids loading to the filters caused them to be backwashed more frequently (from one to two times per day to two to three times per day). Iron addition was discontinued after 19 months.

Although the ratio of soluble iron to soluble arsenic in source water was over 65 (on average) — a value higher than the rule-of-thumb value of 20 — elevated soluble As(V) (close to or over  $10 \mu g/L$ ) continued to be measured through the most of the 4-year study period. Factors affecting removal of soluble As(V) in the filter influent might include elevated phosphorus levels (648  $\mu g/L$  [on average]), elevated silica levels (42.5 mg/L [as SiO<sub>2</sub>] [on average]), and elevated DO levels due to aeration in the aeralater. Aeration continued even after shutting-down of the blower (DO levels reduced from 5.5 to 2.4–3.4 mg/L) and removal of aluminum trays (DO levels further reduced to 2.4 mg/L). Aeration discontinued only after

the aeralater had been bypassed (DO levels further reduced to 0.5 mg/L). The presence of oxygen might have caused some soluble iron to precipitate (even though KMnO<sub>4</sub> or chlorine was added ahead of the aeralater), rendering it ineffective to remove soluble As(V) via adsorption and/or co-precipitation. A series of jar tests were conducted onsite to examine the authenticity of this postulation.

Results of distribution system water sampling before and after system startup indicated that the water quality in the distribution system was comparable to that of the pressure filter effluent. Thus, the treatment system appeared not to have beneficial effects on arsenic, iron, and manganese concentrations. Arsenic concentrations remained essentially unchanged from baseline levels; iron and manganese concentrations actually increased slightly. Alkalinity, pH, and lead concentrations also increased slightly. Copper concentrations increased rather significantly from the average baseline level of  $108 \mu g/L$  to  $267 \mu g/L$ .

Analyses of backwash wastewater samples indicated that approximately 4.9 lb of solids (including 0.01 lb of arsenic, 1.8 lb of iron, and 0.08 lb of manganese) would be disharged, assuming that 87.8 mg/L of total suspended solids (TSS) and 6,752 gal of wastewater would be generated during each backwash event.

The capital investment for the treatment system was \$427,407, including \$281,048 for equipment, \$50,770 for site engineering, and \$95,589 for installation, shakedown, and startup. Using the system's rated capacity of 770 gpm (or 1,108,800 gal/day [gpd]), the capital cost was \$555/gpm (or \$0.38/gpd). This calculation did not include the cost of the building to house the treatment system. O&M cost, estimated at \$0.07/1,000 gal, included only the incremental cost for chemicals, electricity, and labor. Since chlorine addition already existed prior to the demonstration study, the incremental cost for chemical usage was for iron addition only.

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## ABBREVIATIONS AND ACRONYMS

 $\Delta p$  differential pressure

AAL American Analytical Laboratories

Al aluminum AM adsorptive media

As arsenic

ATS Aquatic Treatment Systems

C/F coagulation/filtration

Ca calcium Cl chlorine

CRF capital recovery factor

Cu copper

DBP Disinfection Byproducts

DI deionized

DO dissolved oxygen

EPA U.S. Environmental Protection Agency

F fluoride Fe iron

FeCl<sub>3</sub> ferric chloride

GFH granular ferric hydroxide

gpd gallons per day gph gallons per hour gpm gallons per minute

HAA heloacetic acid HIX hybrid ion exchanger

hp horsepower

ICP-MS inductively coupled plasma-mass spectrometry

ID identification IX ion exchange

LADHH Louisiana Department of Health and Hospitals

LCR (EPA) Lead and Copper Rule

MCL maximum contaminant level MDL method detection limit MEI Magnesium Elektron, Inc.

 $\begin{array}{ll} Mg & magnesium \\ \mu m & micrometer \\ Mn & manganese \\ mV & millivolts \end{array}$ 

Na sodium NA not analyzed

NaOCl sodium hypochlorite

ND not detected

NRMRL National Risk Management Research Laboratory

NS not sampled NSF NSF International

NTU nephelometric turbidity units

O&M operation and maintenance OIP operator interface panel

OIT Oregon Institute of Technology

OPH Office of Public Health

ORD Office of Research and Development

ORP oxidation-reduction potential

P phosphorus

Pb lead

pCi/L picocuries per liter
psi pounds per square inch
psig pounds per square inch gauge
PLC programmable logic controller

PO<sub>4</sub> phosphate POU point-of-use PVC polyvinyl chloride

QA quality assurance

QA/QC quality assurance/quality control QAPP Quality Assurance Project Plan

RPD relative percent difference

RO reverse osmosis

Sb antimony

SDWA Safe Drinking Water Act

SiO<sub>2</sub> silica

SMCL secondary maximum contaminant level

SO<sub>4</sub> sulfate

STS Severn Trent Services

TDS total dissolved solids
THM trihalomethanes
TOC total organic carbon
TSS total suspended solids

UPS uninterruptible power supply

V vanadium

## ACKNOWLEDGMENTS

The authors wish to extend their appreciation to United Water Systems in the Town of Arnaudville, LA for its willingness to participate in this arsenic removal demonstration project. United Water Systems provided manpower to collect samples from the treatment and distribution systems during the performance evaluation study. United Water Systems also assisted in several onsite special studies.

#### 1.0 INTRODUCTION

# 1.1 Background

The Safe Drinking Water Act (SDWA) mandates that the U.S. Environmental Protection Agency (EPA) identify and regulate drinking water contaminants that may have adverse human health effects and that are known or anticipated to occur in public water supply systems. In 1975 under the SDWA, EPA established a maximum contaminant level (MCL) for arsenic (As) at 0.05 mg/L. Amended in 1996, the SDWA required that EPA develop an arsenic research strategy and publish a proposal to revise the arsenic MCL by January 2000. On January 18, 2001, EPA finalized the arsenic MCL at 0.01 mg/L (EPA, 2001). In order to clarify the implementation of the original rule, EPA revised the rule text on March 25, 2003, to express the MCL as 0.010 mg/L (10 µg/L) (EPA, 2003). The final rule required all community and non-transient, non-community water systems to comply with the new standard by January 23, 2006.

In October 2001, EPA announced an initiative for additional research and development of cost-effective technologies to help small community water systems (<10,000 customers) meet the new arsenic standard and to provide technical assistance to operators of small systems in order to reduce compliance costs. As part of this Arsenic Rule Implementation Research Program, EPA's Office of Research and Development (ORD) proposed a project to conduct a series of full-scale, on-site demonstrations of arsenic removal technologies, process modifications, and engineering approaches applicable to small systems. Shortly thereafter, an announcement was published in the *Federal Register* requesting water utilities interested in participating in Round 1 of this EPA-sponsored demonstration program to provide information on their water systems. In June 2002, EPA selected 17 out of 115 sites to host the demonstration studies.

In September 2002, EPA solicited proposals from engineering firms and vendors for cost-effective arsenic removal treatment technologies for the 17 host sites. EPA received 70 technical proposals for the 17 host sites, with each site receiving one to six proposals. In April 2003, an independent technical panel reviewed the proposals and provided its recommendations to EPA on the technologies that it determined were acceptable for the demonstration at each site. Because of funding limitations and other technical reasons, only 12 of the 17 sites were selected for the demonstration project. Using the information provided by the review panel, EPA, in cooperation with the host sites and the drinking water programs of the respective states, selected one technical proposal for each site.

In 2003, EPA initiated Round 2 arsenic technology demonstration projects that were partially funded with Congressional add-on funding to the EPA budget. In June 2003, EPA selected 32 potential demonstration sites, and the United Water Systems' facility in Arnaudville, LA was one of those selected.

In September 2003, EPA again solicited proposals from engineering firms and vendors for arsenic removal technologies. EPA received 148 technical proposals for the 32 host sites, with each site receiving from two to eight proposals. In April 2004, another technical panel was convened by EPA to review the proposals and provide recommendations to EPA with the number of proposals per site ranging from none (for two sites) to a maximum of four. The final selection of the treatment technology at the sites that received at least one proposal was made, again, through a joint effort by EPA, the state regulators, and the host site. Since then, four sites have withdrawn from the demonstration program, reducing the number of sites to 28. Kinetico's Macrolite® arsenic removal technology was selected for demonstration at the Arnaudville facility.

As of April 2011, 39 of the 40 systems was operational, and the performance evaluation of all 39 systems was completed.

# 1.2 Treatment Technologies for Arsenic Removal

The technologies selected for the Round 1 and Round 2 demonstration host sites included 25 adsorptive media (AM) systems (the Oregon Institute of Technology [OIT] site has three AM systems), 13 coagulation/filtration (C/F) systems, two ion exchange (IX) systems, 17 point-of-use (POU) units (including nine under-the-sink reverse osmosis [RO] units at the Sunset Ranch Development site and eight POU-AM units at the OIT site), and one system modification. Table 1-1 summarizes the locations, technologies, vendors, system flowrates, and key source water quality parameters (including As, iron [Fe], and pH) at the 40 demonstration sites. An overview of the technology selection and system design for the 12 Round 1 demonstration sites and the associated capital cost is provided in two EPA reports (Wang et al., 2004; Chen et al., 2004), which are posted on the EPA Web site at http://www.epa.gov/ORD/NRMRL/wswrd/dw/arsenic/index.html.

# 1.3 Project Objectives

The objective of the arsenic demonstration program was to conduct full-scale arsenic treatment technology demonstration studies on the removal of arsenic from drinking water supplies. The specific objectives were to:

- Evaluate the performance of the arsenic removal technologies for use on small systems.
- Determine the required system operation and maintenance (O&M) and operator skill levels.
- Characterize process residuals produced by the technologies.
- Determine the capital and O&M cost of the technologies.

This report summarizes the performance of the Kinetico system at Arnaudville, LA from July 17, 2006, through September 16, 2010. The types of data collected include system operation, water quality (both across the treatment train and in the distribution system), residuals, and capital and preliminary O&M cost.

Table 1-1. Summary of Arsenic Removal Demonstration Sites

				Design	Sourc	e Water Qu	uality
Demonstration				Flowrate	As	Fe	pН
Location	Site Name	Technology (Media)	Vendor	(gpm)	(µg/L)	(µg/L)	(S.U.)
Wales, ME	Springbrook Mobile Home Park	AM (A/I Complex)	ATS	14	38 <sup>(a)</sup>	<25	8.6
Bow, NH	White Rock Water Company	AM (G2)	ADI	70 <sup>(b)</sup>	39	<25	7.7
Goffstown, NH	Orchard Highlands Subdivision	AM (E33)	AdEdge	10	33	<25	6.9
Rollinsford, NH	Rollinsford Water and Sewer District	AM (E33)	AdEdge	100	36 <sup>(a)</sup>	46	8.2
Dummerston, VT	Charette Mobile Home Park	AM (A/I Complex)	ATS	22	30	<25	7.9
Felton, DE	Town of Felton	C/F (Macrolite)	Kinetico	375	30 <sup>(a)</sup>	48	8.2
Stevensville, MD	Queen Anne's County	AM (E33)	STS	300	19 <sup>(a)</sup>	270 <sup>(c)</sup>	7.3
Houghton, NY(d)	Town of Caneadea	C/F (Macrolite)	Kinetico	550	27 <sup>(a)</sup>	1,806 <sup>(c)</sup>	7.6
Buckeye Lake, OH	Buckeye Lake Head Start Building	AM (ARM 200)	Kinetico	10	15 <sup>(a)</sup>	1,312 <sup>(c)</sup>	7.6
Springfield, OH	Chateau Estates Mobile Home Park	AM (E33)	AdEdge	250 <sup>(e)</sup>	25 <sup>(a)</sup>	1,615 <sup>(c)</sup>	7.3
	•	Great Lakes/Interior Plains					
Brown City, MI	City of Brown City	AM (E33)	STS	640	14 <sup>(a)</sup>	127 <sup>(c)</sup>	7.3
Pentwater, MI	Village of Pentwater	C/F (Macrolite)	Kinetico	400	13 <sup>(a)</sup>	466 <sup>(c)</sup>	6.9
Sandusky, MI	City of Sandusky	C/F (Aeralater)	Siemens	340 <sup>(e)</sup>	16 <sup>(a)</sup>	1,387 <sup>(c)</sup>	6.9
Delavan, WI	Vintage on the Ponds	C/F (Macrolite)	Kinetico	40	20 <sup>(a)</sup>	1,499 <sup>(c)</sup>	7.5
Greenville, WI	Town of Greenville	C/F (Macrolite)	Kinetico	375	17	7827 <sup>(c)</sup>	7.3
Climax, MN	City of Climax	C/F (Macrolite)	Kinetico	140	39 <sup>(a)</sup>	546 <sup>(c)</sup>	7.4
Sabin, MN	City of Sabin	C/F (Macrolite)	Kinetico	250	34	1,470 <sup>(c)</sup>	7.3
Sauk Centre, MN	Big Sauk Lake Mobile Home Park	C/F (Macrolite)	Kinetico	20	25 <sup>(a)</sup>	3,078 <sup>(c)</sup>	7.1
Stewart, MN	City of Stewart	C/F&AM (E33)	AdEdge	250	42 <sup>(a)</sup>	1,344 <sup>(c)</sup>	7.7
Lidgerwood, ND	City of Lidgerwood	Process Modification	Kinetico	250	146 <sup>(a)</sup>	1,325 <sup>(c)</sup>	7.2
		Midwest/Southwest					
Arnaudville, LA	United Water Systems	C/F (Macrolite)	Kinetico	770 <sup>(e)</sup>	35 <sup>(a)</sup>	2,068 <sup>(c)</sup>	7.0
Alvin, TX	Oak Manor Municipal Utility District	AM (E33)	STS	150	19 <sup>(a)</sup>	95	7.8
	Webb Consolidated Independent School						
Bruni, TX	District	AM (E33)	AdEdge	40	56 <sup>(a)</sup>	<25	8.0
Wellman, TX	City of Wellman	AM (E33)	AdEdge	100	45	<25	7.7
	Desert Sands Mutual Domestic Water						
Anthony, NM	Consumers Association	AM (E33)	STS	320	23 <sup>(a)</sup>	39	7.7
Nambe Pueblo, NM	Nambe Pueblo Tribe	AM (E33)	AdEdge	145	33	<25	8.5
Taos, NM	Town of Taos	AM (E33)	STS	450	14	59	9.5
Rimrock, AZ	Arizona Water Company	AM (E33)	AdEdge	90 <sup>(b)</sup>	50	170	7.2
Tohono O'odham							
Nation, AZ	Tohono O'odham Utility Authority	AM (E33)	AdEdge	50	32	<25	8.2
Valley Vista, AZ	Arizona Water Company	AM (AAFS50/ARM 200)	Kinetico	37	41	<25	7.8

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Table 1-1. Summary of Arsenic Removal Demonstration Sites (Continued)

				Design	Sourc	e Water Qu	uality
Demonstration				Flowrate	As	Fe	pН
Location	Site Name	Technology (Media)	Vendor	(gpm)	(µg/L)	(μg/L)	(S.U.)
		Far West					
Three Forks, MT	City of Three Forks	C/F (Macrolite)	Kinetico	250	64	<25	7.5
Fruitland, ID	City of Fruitland	IX (A300E)	Kinetico	250	44	<25	7.4
Homedale, ID	Sunset Ranch Development	POU RO <sup>(f)</sup>	Kinetico	75 gpd	52	134	7.5
Okanogan, WA	City of Okanogan	C/F (Electromedia-I)	Filtronics	750	18	69 <sup>(c)</sup>	8.0
		POE AM (Adsorbsia/ARM 200/ArsenX <sup>np</sup> )					
Klamath Falls, OR	Oregon Institute of Technology	And POU AM (ARM 200)(g)	Kinetico	60/60/30	33	<25	7.9
Vale, OR	City of Vale	IX (Arsenex II)	Kinetico	525	17	<25	7.5
	South Truckee Meadows General						
Reno, NV	Improvement District	AM (GFH/Kemiron)	Siemens	350	39	<25	7.4
Susanville, CA	Richmond School District	AM (A/I Complex)	ATS	12	37 <sup>(a)</sup>	125	7.5
Lake Isabella, CA	Upper Bodfish Well CH2-A	AM (HIX)	VEETech	50	35	125	7.5
Tehachapi, CA	Golden Hills Community Service District	AM (Isolux)	MEI	150	15	<25	6.9

AM = adsorptive media; C/F = coagulation/filtration; GFH = granular ferric hydroxide; HIX = hybrid ion exchanger; IX = ion exchange; RO = reverse osmosis

ATS = Aquatic Treatment Systems; MEI = Magnesium Elektron, Inc.; STS = Severn Trent Services

- (a) Arsenic existing mostly as As(III).
- (b) Design flowrate reduced by 50% after system was switched from parallel to serial configuration.
- (c) Iron existing mostly as Fe(II).
- (d) Withdrew from program in 2007. Selected originally to replace Village of Lyman, NE site, which withdrew from program in June 2006.
- (e) Facilities upgraded Springfield, OH system from 150 to 250 gpm, Sandusky, MI system from 210 to 340 gpm, and Arnaudville, LA system from 385 to 770 gpm.
- (f) Including nine residential units.
- (g) Including eight under-the-sink units.

#### 2.0 SUMMARY AND CONCLUSIONS

Based on the information collected from operation of Kinetico's FM-286-AS pressure filtration system using Macrolite® media at United Water Systems' facility in Arnaudville, LA from July 17, 2006, through September 16, 2010, the following summary and conclusions are provided relating to the overall objectives of the treatment technology demonstration study.

Performance of the arsenic removal technology for use on small systems:

- KMnO<sub>4</sub> was effective in oxidizing soluble As(III) to soluble As(V) and soluble Fe(II) to iron solids. Chlorine also was effective in oxidizing soluble As(III) and soluble Fe(II) even with the presence of 1.9 mg/L of ammonia (as N) (on average).
- Unintentional aeration in the aeralater caused extensive biofouling in filter beds. An acid and a caustic wash using 10% HCl and 10% NaOH can restore the filter media. Biological activities, including nitrification, can be controlled by minimizing aeration.
- Aeration in the aeralater apparently caused some soluble iron to precipitate, rendering it ineffective in removing soluble As(V) via adsorption and/or co-precipitation. As a consequence, elevated soluble As(V) levels (close to or over 10 μg/L) were measured in the filter effluent during most of the 4-year study period, regardless of the choice of oxidants.
- Aeration can be eliminated by bypassing the aeralater. Without oxygen, soluble As(V) can be reduced to  $<6 \mu g/L$  based on results of a series of jar tests.
- The effect of supplemental iron addition on arsenic removal was inconclusive, due, in part, to operational issues, such as the use of an oversized pump and a corroding/dissolving impeller/mixer. The use of supplemental iron added extra loading to the filters, thus requiring more frequent backwash.
- Backwash can restore the filter media, but useful filter run lengths were short, averaging <4 hr (at an average filtration rate of 4.4 gpm/ft²). The backwash frequency went from once to twice a day a few months into the study, to as many as eight times a day after the media was fouled, to as many as 16 times a day when supplemental iron was added.

## Required system O&M and operator skill levels:

• The daily demand on the operator was short, averaging 30 min for routine O&M. However, the operator spent a significant amount of time assisting in troubleshooting system operational issues (such as biofouling of filter media and corrosion/dissolution of mixing equipment) and repairing the system (such as pipe breaks).

## Characteristics of residuals produced by the technology:

- The amount of wastewater generated was equivalent to 5.5% of the water production, which is much higher than that at other Macrolite® pressure filtration sites.
- Approximately 4.9 lb of solids was produced during each backwash event, including 1.8 lb of iron, 0.08 lb of manganese, and 0.01 lb of arsenic.

# Capital and O&M cost of the technology:

- The capital investment for the system was \$427,407, including \$281,048 for equipment, \$50,770 for site engineering, and \$95,589 for installation, shakedown, and startup.
- The unit capital cost was \$555/gpm (or \$0.38/gpd) based on a 770-gpm design flowrate. This calculation does not reflect the building cost as it was funded by United Water Systems.

labor.	st was \$0.07/1,00		

#### 3.0 MATERIALS AND METHODS

# 3.1 General Project Approach

Following the predemonstration activities summarized in Table 3-1, the performance evaluation study of the Kinetico treatment system began on July 17, 2006, and ended on September 16, 2010. Table 3-2 summarizes the types of data collected and considered as part of the technology evaluation process. The overall system performance was based on its ability to consistently remove arsenic to below the target MCL of  $10~\mu g/L$  through the collection of water samples across the treatment train. The reliability of the system was evaluated by tracking the unscheduled system downtime and frequency and extent of repair and replacement. The unscheduled downtime and repair information were recorded by the plant operator on a Repair and Maintenance Log Sheet.

The O&M and operator skill requirements were assessed through quantitative data and qualitative considerations, including the need for pre- and/or post-treatment, level of system automation, extent of preventative maintenance activities, frequency of chemical and/or media handling and inventory, and general knowledge needed for relevant chemical processes and related health and safety practices. The staffing requirements for the system operation were recorded on an Operator Labor Hour Log Sheet.

The quantity of aqueous and solid residuals generated was estimated by tracking the volume of backwash water produced during each backwash cycle. Backwash wastewater was sampled and analyzed for chemical characteristics.

The cost of the system was evaluated based on the capital cost per gal/min (gpm) (or gal/day [gpd]) of design capacity and the O&M cost per 1,000 gal of water treated. This task required tracking the capital cost for equipment, engineering, and installation, as well as the O&M cost for media replacement and disposal, chemical supply, electricity usage, and labor.

Table 3-1. Predemonstration Study Activities and Completion Dates

Activity	Date
Introductory Meeting Held	November 3, 2004
Project Planning Meeting Held	March 21, 2005
Final Letter of Understanding Issued	April 8, 2005
Request for Quotation Issued to Vendor	April 13, 2005
Vendor Quotation Received b Battelle	May 3, 2005
Purchase Order Completed and Signed	May 23, 2005
Engineering Plan Submitted to LADHH/OPH	August 19, 2005
System Permit Issued by LADHH/OPH	September 16, 2005
Pre-construction Meeting Held	February 27, 2006
Notice to Proceed Issued to Building Contractor	March 6, 2006
Treatment Equipment Arrived	April 10, 2006
System Installation Complete	June 7, 2006
System Start-up and Shakedown Completed	June 23, 2006
Performance Evaluation Begun	July 17, 2006
Final Study Plan Issued	August 7, 2006
Request for FeCl <sub>3</sub> Addition Submitted to LADHH/OPH	June 21, 2007
Request Granted by LADHH/OPH	August 8, 2007

LADHH = Louisiana Department of Health and Hospitals; OPH = Office of Public Health

Table 3-2. Evaluation Objectives and Supporting Data Collection Activities

Evaluation Objective	Data Collection
Performance	-Ability to consistently meet 10 μg/L of arsenic in treated water
Reliability	-Unscheduled system downtime
	-Frequency and extent of repairs including a description of problems,
	materials and supplies needed, and associated labor and cost
System O&M and Operator	-Pre- and post-treatment requirements
Skill Requirements	-Level of automation for system operation and data collection
	-Staffing requirements including number of operators and laborers
	-Task analysis of preventative maintenance including number, frequency, and complexity of tasks
	-Chemical handling and inventory requirements
	-General knowledge needed for relevant chemical processes and health and safety practices
Residual Management	-Quantity and characteristics of aqueous and solid residuals generated by system operation
System Cost	-Capital cost for equipment, engineering, and installation
-	-O&M cost for chemical usage, electricity consumption, and labor

# 3.2 System O&M and Cost Data Collection

The plant operator performed daily, weekly, and/or monthly system O&M and data collection upon Battelle's requests. On a daily basis, the plant operator recorded system operational data, such as pressure, flowrate, totalizer, and hour meter readings on a Daily System Operation Log Sheet, checked potassium permanganate (KMnO<sub>4</sub>), ferric chloride (FeCl<sub>3</sub>), and/or sodium hypochlorite (NaOCl) levels, and conducted visual inspections to ensure normal system operations. If any problem occurred, the plant operator contacted the Battelle Study Lead, who determined if the vendor should be contacted for troubleshooting. The plant operator recorded all relevant information, including the problem encountered, course of actions taken, materials and supplies used, and associated cost and labor incurred, on a Repair and Maintenance Log Sheet. To the extent possible, the plant operator measured several water quality parameters onsite, including temperature, pH, dissolved oxygen (DO), oxidation-reduction potential (ORP), and residual chlorine, and recorded them on an Onsite Water Quality Parameters Log Sheet. Monthly backwash data also were recorded on a Backwash Log Sheet.

The capital cost for the arsenic removal system consisted of the cost for equipment, site engineering, and system installation. The O&M cost consisted of the cost for chemical usage, electricity consumption, and labor. Consumption of KMnO<sub>4</sub>, FeCl<sub>3</sub>, and/or NaOCl was tracked on the Daily System Operation Log Sheet. Electricity consumption was determined from utility bills. Labor for various activities, such as routine system O&M, troubleshooting and repairs, and demonstration-related work, was tracked using an Operator Labor Hour Log Sheet. The routine system O&M included activities such as completing field logs, replenishing the chemical solutions, ordering supplies, performing system inspections, and others as recommended by the vendor. The labor for demonstration-related work, including activities such as performing field measurements, collecting and shipping samples, and communicating with the Battelle Study Lead and the vendor, was recorded, but not used for the cost analysis.

# 3.3 Sample Collection Procedures and Schedules

To evaluate system performance, water samples were collected at the wellhead, across the treatment plant, during Macrolite<sup>®</sup> filter backwash, from the distribution system and during one hydrant flush event. Table 3-3 presents the sampling schedule and analytes measured during each sampling event. In addition,

Table 3-3. Sampling Schedule and Analyses

Sample	Sample	No. of			Collection
Type	Locations(a)	Samples	Frequency	Analytes	Date
Source Water	IN	I	Once	Onsite: pH, temperature, DO, and ORP  Offsite: As(III), As(V), As (total and soluble), Fe (total and soluble), Mn (total and soluble), U (total and soluble), V (total and soluble), V (total and soluble), Na, Ca, Mg, F, Cl, NO <sub>2</sub> , NO <sub>3</sub> , NH <sub>3</sub> , SO <sub>4</sub> , SiO <sub>2</sub> , PO <sub>4</sub> , TDS, TOC, turbidity, and alkalinity	11/03/04
Treatment Plant Water (Regular)	IN, AC, TA, and TB	4	Varying	Onsite: pH, temperature, DO, ORP, and/or total Cl <sub>2</sub> <sup>(b)</sup> Offsite: As (total), Fe (total), Mn (total), SiO <sub>2</sub> , P, turbidity, and alkalinity	See Appendix B
Treatment Plant Water (Speciation)	IN, AC, and TT	3	Varying	Onsite: pH, temperature, DO, ORP, and/or total Cl <sub>2</sub> <sup>(c)</sup> Offsite: As(III), As(V), As (total and soluble), Fe (total and soluble), Mn (total and soluble), Ca, Mg, F, NO <sub>3</sub> , NH <sub>3</sub> , SO <sub>4</sub> , SiO <sub>2</sub> , P, TOC, turbidity, and/or alkalinity	See Appendix B
Backwash Wastewater	BW	2	Varying	pH, TSS, TDS, As (total and soluble), Fe (total and soluble), Mn (total and soluble)	See Table 4-14
Residual Solids	Backwash Solids from Each Tank	2	Once	Total Ag, As, Ba, Cd, Cr, Hg, Pb, and Se	Not performed
Distribution Water	Three LCR Residences	3	Monthly <sup>(d)</sup>	pH, alkalinity, As (total), Fe (total), Mn (total), Pb, and Cu	See Table 4-15

<sup>(</sup>a) Abbreviations corresponding to sample locations in Figure 3-1, i.e., IN = at wellhead; AC = after contact tank; TA = after Vessel A; TB = after Vessel B; TT = after Vessels A and B combined; BW = at backwash discharge line; SS = sludge sampling location.

<sup>(</sup>b) At AC, TA, and/or TB only.

<sup>(</sup>c) At AC and/or TT only.

<sup>(</sup>d) Discontinued on 04/03/07.

Figure 3-1 presents a flow diagram of the treatment system along with the analytes and schedule for each sampling location. Specific sampling requirements for analytical methods, sample volumes, containers, preservation, and holding times are presented in Table 4-1 of the EPA-endorsed Quality Assurance Project Plan (QAPP) (Battelle, 2004). The procedure for arsenic speciation is described in Appendix A of the QAPP.

- **3.3.1 Source Water.** During the initial site visit on November 3, 2004, one set of source water samples from Wells 1 and 2 was collected and speciated using arsenic speciation kits (Section 3.4.1). Before sampling, sample taps were flushed for several minutes; special care was taken to avoid agitation, which might cause unwanted oxidation. The samples were analyzed for analytes listed in Table 3-3. Arsenic speciation kits and containers for water quality samples were provided by Battelle and American Analytical Laboratories (AAL), respectively. Sample containers for total organic carbon (TOC) were provided by TCCI Laboratories, Inc.
- **3.3.2 Treatment Plant Water**. The Battelle Study Plan (Battelle, 2006) called for the collection of weekly treatment plant water samples on a four-week cycle. For the first week of each four-week cycle, samples were collected at the wellhead (IN), after the contact tank (AC), and after Vessels A and B combined (TT), speciated onsite, and analyzed for the analytes listed under "Treatment Plant Speciation Sampling" in Table 3-3. For the next three weeks, samples were collected at IN, AC, after Vessel A (TA), and after Vessel B (TB) and analyzed for the analytes listed under "Treatment Plant Regular Sampling" in Table 3-3.

Due to various operational issues encountered during the performance evaluation study, speciation and regular sampling were performed as scheduled only between August 10, 2006, through April 30, 2007 (except for five sampling events on November 28, 2006, December 19, 2006, January 1, 2007, February 21, 2007, and April 30, 2007, when biweekly samples were collected due to holidays and other logistic issues). After April 30, 2007, sampling discontinued and resumed a number of times for the following reasons:

- Poor system performance led the project team to believe that supplemental iron addition was necessary to enhance soluble arsenic removal by the treatment system. Sampling discontinued after April 30, 2007, to await the installation of an iron addition system. Sampling resumed on January 23, 2008, with onsite speciation for arsenic, iron, and manganese only. Five additional sampling events followed on January 28, March 11, March 19, March 24, and April 17, 2008. For the March 19 and March 24 samples, total phosphorus also was analyzed.
- Irregularities on iron dosing occurred after implementation of iron addition. Sampling discontinued after April 17, 2008 to await results of a run length study by the operator. Despite the fact that irregular iron dosing continued, sampling with onsite speciation for arsenic, iron and manganese resumed on November 18, 2008, and lasted until March 30, 2009. During this period, seven sampling events took place, with one each in November and December 2008, two in January 2009, and three in March 2009.
- Upon conferring with the operator, it was determined that aeration in the aeralater in fact continued. To minimize aeration, the operator agreed to remove aluminum trays in the aeralater and cut the standpipe 4 ft below the high-level sensor in the aeralater. Meanwhile, supplemental iron addition was suspended. Speciation sampling as noted in Table 3-3 resumed on August 18, 2009, and lasted until August 5, 2010. A total of 19 sampling events took place, with one in August 2009, four each in September and October 2009, three in November 2009, one in December 2009, three in January 2010, two in February 2010, and one in August 2010.

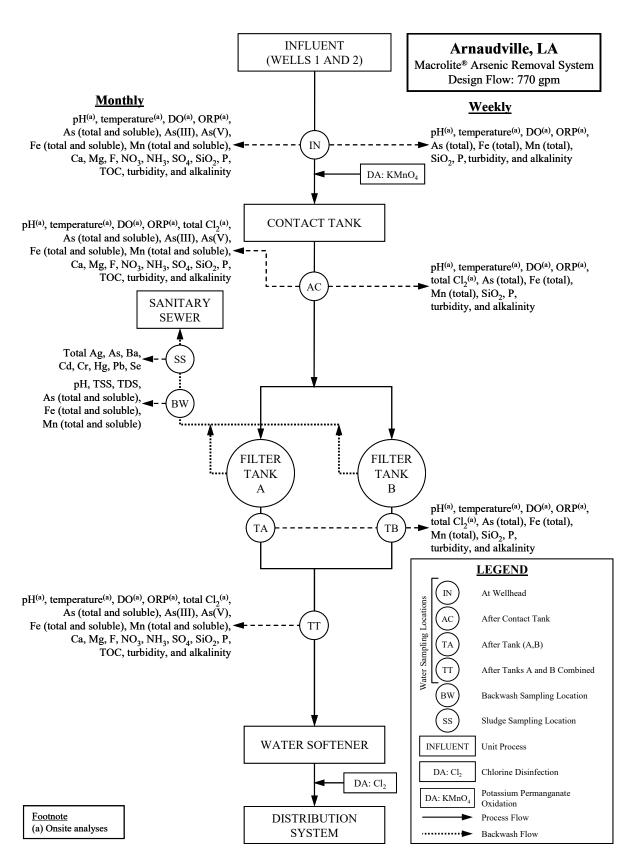


Figure 3-1. Process Flow Diagram and Sampling Schedule and Locations

- 3.3.3 Backwash Wastewater. Monthly backwash wastewater samples were collected six times by the plant operator between September 19, 2006, and March 25, 2007. Backwash wastewater samples were collected by directing a portion of backwash wastewater at approximately 1 gpm to a clean, 32-gal container over the duration of backwash for each vessel. This sidestream was produced via plastic tubing connecting to a tap on the backwash wastewater discharge line. After the content in the container was thoroughly mixed, composite samples were collected and/or filtered onsite with 0.45-µm disc filters. Analytes for the backwash wastewater samples are listed in Table 3-3.
- **3.3.4 Distribution System Water.** Water samples were collected from the distribution system to determine the impact of the arsenic treatment system on the water chemistry in the distribution system, specifically, arsenic, lead, and copper levels. Prior to system startup from August 2005 to January 2006, four monthly baseline distribution system water samples were collected from three residences within the town's historic Lead and Copper Rule (LCR) sampling network. Following system startup, distribution system water sampling began in September 2006 and ended in April 2007 on a monthly basis at the same three locations.

Homeowners collected samples following an instruction sheet developed according to the *Lead and Copper Monitoring and Reporting Guidance for Public Water Systems* (EPA, 2002). The dates and times of last water usage before sampling and of actual sample collection were recorded for determination of the stagnation time. Except for one on November 30, 2005, all samples were collected from a cold-water faucet that had not been used for at least 6 hr to ensure that stagnant water was sampled.

**3.3.5 Residual Solids.** Residual solids produced consisted of only backwash wastewater solids. Per the Battelle Study Plan, solid samples would be collected on two occasions after solids in backwash wastewater had settled (in a 32-gal container) and supernatant had been carefully decanted. A portion of each of the solids/water mixtures would then be air-dried for metals analyses. Residual solid sampling was planned but never actually performed during the performance evaluation study.

# 3.4 Special Studies

Due to on-going problems with system performance, several special studies were conducted to examine possible causes and solutions to improve performance. The studies performed included several filter run length studies and a series of jar tests.

3.4.1 Filter Run Length Studies. Filter run length studies were conducted by collecting a series of effluent samples from one or both pressure filters to determine useful run lengths between two consecutive backwash events. Filtered (with  $0.45 \mu m$  disc filters) and unfiltered samples collected at predetermined time intervals were analyzed for total and soluble metals and/or some or all of the other analytes listed in Table 3-4.

emperature ength (hr) e, and Mn Soluble As, Filter Run As, \mmonia ind Mn Cotal As(V) TOC 00 ΙN 0 X × Χ AC 0 X X × X × X × TA/TB X × × × × ×

Table 3-4. Test Matrix for Run Length Studies

**3.4.2 Jar Tests.** A series of jar tests were conducted from January 18 to 22, 2010, to determine (1) the most effective oxidant, (2) a proper dosage, and (3) arsenic and iron removal using select doses of oxidants. During system startup and until March 29, 2007, KMnO<sub>4</sub> had been used for oxidizing arsenic, iron, and manganese. Although effective, concerns about biofouling of the filter media prompted the use of chlorine. Residual chlorine levels in system effluent (or influent to the softening unit) had to be kept below 1.0 mg/L (as Cl<sub>2</sub>) because the synthetic zeolite in the softening unit might be sensitive to chlorine.

The first part of the jar tests used three doses of NaOCl and three doses of KMnO<sub>4</sub> to gain information about an optimal dosage for each oxidant. One dose of NaOCl and all three doses of KMnO<sub>4</sub> were then used to examine their effectiveness in treating arsenic, iron, and manganese in source water. Due to the presence of ammonia in source water, NaOCl would react with ammonia to form chloramines, which would reduce oxidation kinetics. Breakpoint chlorination could not be used because it would result in unacceptably high chemical use. When using KMnO<sub>4</sub>, colloidal MnO<sub>2</sub> particles might form due to the presence of TOC in source water; colloidal particles might not be removed by the filter media (Pellitier, 2010). Additional KMnO<sub>4</sub> might be added to "offset" effects exerted by TOC, based on observations made during studies at arsenic demonstration sites such as Sauk Centre, MN (Shiao et al., 2009) and Waynesville, IL (Chen et al., 2011; 2010c). Specific procedures developed for the jar tests are described below.

3.4.2.1 Raw Water Collection. Raw water was collected from the wellhead sample tap in a manner that minimized oxidation of source water and preserved its in-well characteristics throughout its use. After turning off the gas chlorine addition valve and thoroughly flushing the sample tap for at least 15 min, raw water was filled into a 2.5-gal partially opaque jug at a low flowrate from the bottom using Tygon® tubing. Once the jug was filled, it was allowed to overflow to remove layers of potentially oxidized water. Thus, potential oxidation of raw water was diffusion-limited to a small layer near the air/water interface within the jug and relatively far away from the sample tap located near the bottom of the jug. The last 1 gal of water from the jug was not used for the studies. pH, DO, ORP, and temperature were measured directly from the bottom of the overflowing jug.

In addition to the sample tap, the jug also was equipped with a small hole on its top to provide pressure during sampling. When the sampling tap was not open, the hole was covered with a piece of tape to reduce air intrusion. The water just below the interface was periodically observed during the experiment for signs of oxidation (light attenuation and scattering caused by the precipitation of oxidized metals); however, this proved difficult, since the sample jug was partially opaque. No signs of significant oxidation were noted during the study, although a slight yellow hue was noted in the jug approximately 60 min after collection. Water with an appreciably noticeable yellow hue was disposed of and fresh raw water was used in its place.

3.4.2.2 Jar Test Procedures. The jar tests were carried out using raw water collected as described in Section 3.4.2.1. 1-L amber glass jars were spiked with appropriate amounts of an oxidant and then filled with raw water from the 2.5-gal jug. The actual oxidant dose was determined by spiking 1-L amber jars filled with deionized (DI) water and measuring respective oxidant concentrations. Care was taken to minimize agitation when filling the jars. The jars were mixed by inverting them with the aid of stainless steel weights added prior to raw water addition.

To determine an appropriate contact time, a simple calculation was made using the contact tank volume and average flowrate to the contact tank; the ratio of these provided the hydraulic detention time within the contact tank. The contact time within the tank was found to be about 20 min; therefore, a 20-min contact time was used for all jar tests.

After the 20-min contact time, contents in some 1-L jars were measured for residual chlorine or KMnO<sub>4</sub> to determine optimal doses (see Table 3-5). For arsenic and iron removal, an extended suite of analytes, including metal speciation, ammonia, TOC, pH, temperature, DO, and ORP also were analyzed (see Table 3-6). The order of the sampling/measurements (as presented herein) was important to ensure that minimal oxygen dissolution occurred while the 1-L jars were open to the atmosphere. All samples were taken with a sterile 25-mL pipette from the bottom of the jars.

Table 3-5. Test Matrix for Determining Optimal Oxidant Doses

Oxidant	Oxidant Dose (as mg/L Cl <sub>2</sub> or KMnO <sub>4</sub> )	Reaction Time (min)	Total Chlorine	KMnO4
NaOCl	0.0	20	×	
	2.2	20	×	
	4.2	20	×	
	7.1	20	×	
KMnO <sub>4</sub>	0.0	20		×
	1.9	20		×
	4.2	20		×
	6.6	20		×

Table 3-6. Test Matrix for Arsenic and Iron Removal

Oxidant	Oxidant Dose (as mg/L Cl <sub>2</sub> or KMnO <sub>4</sub> )	action (	pH	Temperature	00	ORP	Total Chlorine	KMnO4	Total As, Fe, and Mn	49 ≒	As(III)	As(V)	Ammonia	T0C
None	0	-	X	×	×	×	×	×	×	×	×	×	×	×
NaOCl	2.2	20	×	×	×	×	×	-	×	×	×	×	×	×
KMnO <sub>4</sub>	1.9	20	X	×	×	×	-	×	×	×	×	×	×	×
	4.2	20	X	×	×	×	-	×	×	×	×	×	×	×
	6.6	20	X	×	×	×	-	×	×	×	×	×	×	×

3.4.2.3 Aeralater Bypass. A valve that diverted the flow to the aeralater was closed so that well water, after chlorination, could flow directly into the Marcrolite® pressure filters via a 4-in pipe. With the diversion valve closed, samples collected from the AC location represented water that had not been aerated. One sample each was collected both before and after aeralater bypass. The samples were then speciated for total and soluble arsenic, iron, and manganese, soluble As(III), and soluble As(V), and analyzed for NH<sub>3</sub>, pH, temperature, ORP, DO, and total chlorine.

#### 3.5 Sampling Logistics

**3.5.1 Preparation of Arsenic Speciation Kits.** The arsenic field speciation method uses an anion exchange resin column to separate the soluble arsenic species, As(V) and As(III) (Edwards et al., 1998). Resin columns were prepared in batches at Battelle laboratories according to the procedures detailed in Appendix A of the QAPP (Battelle, 2004).

3.5.2 Preparation of Sample Coolers. For each sampling event, a sample cooler was prepared with the appropriate number and type of sample bottles, disc filters, and/or speciation kits. All sample bottles were new and contained appropriate preservatives. Each sample bottle was affixed with a preprinted, colored-coded label consisting of the sample identification (ID), date and time of sample collection, collector's name, site location, sample destination, analysis required, and preservative. The sample ID consisted of a two-letter code for the demonstration site, the sampling date, a two-letter code for a specific sampling location, and a one-letter code designating the arsenic speciation bottle (if necessary). The sampling locations at the treatment plant were color-coded for easy identification. The labeled bottles were separated by sampling location, placed in zip-lock bags, and packed into the cooler.

In addition, all sampling- and shipping-related materials, such as disposable gloves, sampling instructions, chain-of-custody forms, prepaid/addressed FedEx air bills, and bubble wrap, were included. The chain-of-custody forms and air bills were complete except for the operator's signature and the sample dates and times. After preparation, the sample cooler was sent to the site via FedEx for the following week's sampling event.

3.5.3 Sample Shipping and Handling. After sample collection, samples for offsite analyses were packed carefully in the original coolers with wet ice and shipped back to Battelle. Upon receipt, the sample custodian verified that all samples indicated on the chain-of-custody forms were included and intact. Sample IDs were checked against the chain-of-custody forms, and the samples were logged into the laboratory sample receipt log. Discrepancies noted by the sample custodian were addressed with the plant operator by the Battelle Study Lead.

Samples for metal analyses were stored at Battelle's inductively coupled plasma-mass spectrometry (ICP-MS) laboratory. Samples for other water quality analyses were packed in separate coolers and picked up by couriers from AAL in Columbus, OH and TCCI Laboratories in New Lexington, OH, which were both under contract with Battelle for this demonstration study. The chain-of-custody forms remained with the samples from the time of preparation through analysis and final disposition. All samples were archived by the appropriate laboratories for the respective duration of the required hold time and disposed of properly thereafter.

#### 3.6 Analytical Procedures

The analytical procedures described in Section 4.0 of the QAPP (Battelle, 2004) were followed by Battelle's ICP-MS laboratory, AAL, and TCCI Laboratories, and Belmont Labs. Laboratory quality assurance/quality control (QA/QC) of all methods followed the prescribed guidelines. Data quality in terms of precision, accuracy, method detection limits (MDLs), and completeness met the criteria established in the QAPP (i.e., relative percent difference [RPD] of 20%, percent recovery of 80 to 120%, and completeness of 80%). The QA data associated with each analyte will be presented and evaluated in a QA/QC Summary Report to be prepared under separate cover upon completion of the Arsenic Demonstration Project.

Field measurements of pH, temperature, DO, and ORP were conducted by the plant operator using a handheld field meter, which was calibrated for pH and DO prior to use following the procedures provided in the user's manual. The ORP probe also was checked for accuracy by measuring the ORP of a standard solution and comparing it to the expected value. The plant operator collected a water sample in a clean, plastic beaker and placed the probe in the beaker until a stable value was obtained. The plant operator also performed free and total chlorine measurements using Hach chlorine test kits following the user's manual.

#### 4.0 RESULTS AND DISCUSSION

# 4.1 Site Description

**4.1.1 Pre-existing Facility.** Located at 1004 Twin Oaks Drive in Arnaudville, LA, United Water Systems Treatment System served approximately 1,200 service connections in rural areas of Arnaudville, Cecilia, Breaux Bridge, and Bayou Portage in St. Landry and St. Martin Parishes. The system was supplied by two 10-in production wells, i.e., Wells No. 1 and No. 2, drilled to a depth of approximately 560 ft. Each well was equipped with a 15-horsepower (hp) submersible pump rated for 350 or 375 gpm against a 90-lb/in<sup>2</sup> (psi) head. Prior to the demonstration project, the wells alternated with each well operating approximately four times per day for a total daily operating time of 15 to 23 hr. The typical daily water usage was between 280,000 to 380,000 gpd with an estimated peak daily demand of 400,000 gpd.

The pre-existing treatment system consisted of aeration, prechlorination, sand filtration, softening, post-chlorination, and zinc orthophosphate addition (Figure 4-1). Aeration was performed at the top section of an 11-ft diameter aeralater (Figure 4-2) to oxidize soluble iron. Chlorine addition occurred within the aeralater to achieve further oxidation. The chlorinated water passed through a gravity filter within the aeralater and to a separate pressure filter to remove precipitated iron particles. Seventy percent of the water from the pressure filter was then treated by a synthetic zeolite water softener for hardness removal (Figure 4-3). The other 30% bypassed the softener and was blended with the softened water before post-chlorination and storage onsite in a 127,000-gal storage tank (Figure 4-4). Treated water in the storage tank was transferred to a 10,000-gal hydropneumatic tank (Figure 4-5) before entering the distribution system.

System piping and flow path/control were arranged so that raw water was fed from one of the two wells into a manifold and a 6-in standpipe leading toward the top of the aeralater. The well pumps were

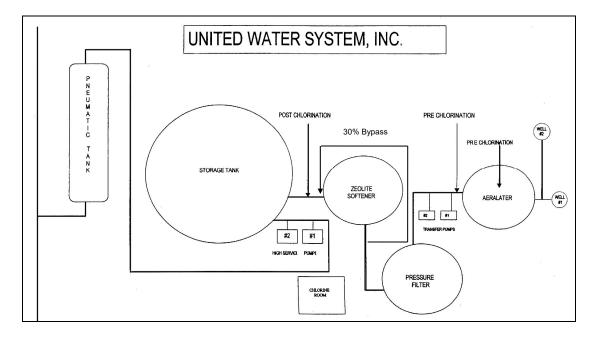


Figure 4-1. Pre-existing Treatment Train



Figure 4-2. Pre-existing Aeralater



Figure 4-3. Pre-existing Water Softener



Figure 4-4. Pre-existing Storage Tank (center) with Hydropneumatic Tank at Its Side (left)



Figure 4-5. Pre-existing Hydropneumatic Tank

controlled by a set of high- and low-level sensors within the top section of the aeralater. Water discharged from the standpipe splashed downward through a series of aluminum trays where air was forced from a blower to aerate the water. After passing the gravity filter within the aeralater, water was pumped by two transfer pumps (Figure 4-6) to the pressure filter and water softener before entering the 127,000-gal storage tank. The transfer pumps were controlled by a set of high- and low-level sensors in the storage tank. Treated water in the storage tank was transferred by two high service pumps to a 10,000-gal hydropneumatic tank before entering the distribution system. A pair of high- and low-level sensors in the hydropneumatic tank controlled the flow from the storage tank to the hydropneumatic tank.



Figure 4-6. Pre-existing Transfer Pumps

For the arsenic removal technology demonstration, the pre-existing aeralater was used as a contact tank (instead of an aerator and a gravity filtration unit) and two Macrolite® pressure filters were installed to replace the pre-existing pressure filter. Other pre-existing system components and piping and flow path/control arrangements remained mostly unchanged.

- **4.1.2 Distribution System.** The distribution system was a closed looped distribution line supplied via the 127,000-gal storage tank by Wells No. 1 and No. 2. The distribution line was constructed of 2-in to 6-in Schedule 40 and Class 160 polyvinyl chloride (PVC) piping. United Water Systems sampled daily for chlorine residuals, monthly for bacterial analysis, and once every three years at 10 residences under the LCR. The facility also performed regular sampling for volatile organic compounds (VOCs), metals, and pesticides approximately once every three years or as directed by the LADHH/OPH.
- **4.1.3 Source Water Quality.** Source water samples from Wells No. 1 and No. 2 were collected and speciated by Battelle on November 3, 2004. Analytical results from the source-water sampling are presented in Table 4-1 and compared to those taken by the facility, Kinetico, and the Louisiana Department of Health and Hospitals/Office of Public Health (LDHH/OPH).

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Table 4-1. Source Water Quality Data

		Facility Data		Kinetico Data	Battelle Data		LDHH/OPH Data			
		Well	Well	Dist.	2	Well	Well	Well	Well	Dist.
Parameter	Unit	No. 1	No. 2	System	Well	No. 1	No. 2	No. 1	No. 2	System
	Date	-	-	_	-	11/03/04		04/26/99-07/07/03		
рН	S.U.	7.3	7.2	NA	7.0	7.0	7.0	7.1–7.3	7.0	NA
Temperature	°C	NA	NA	NA	NA	21.1	20.7	NA	NA	NA
DO	mg/L	NA	NA	NA	NA	0.4	0.7	NA	NA	NA
ORP	mV	NA	NA	NA	NA	-105	-101	NA	NA	NA
Total Alkalinity(a)	mg/L	309	315	NA	312	308	308	298-305	302-313	NA
Hardness <sup>(a)</sup>	mg/L	NA	NA	42	290	316	294	173-243	170-224	NA
Turbidity	NTU	NA	NA	NA	NA	25.0	20.0	0.6-3.2	3.1-7.0	NA
TDS	mg/L	NA	NA	NA	NA	392	336	396-416	354–364	NA
TOC	mg/L	NA	NA	NA	NA	2.1	1.5	NA	NA	NA
Nitrate (as N)	mg/L	NA	NA	NA	NA	< 0.04	< 0.04	< 0.014	< 0.014	NA
Nitrite (as N)	mg/L	NA	NA	NA	NA	< 0.01	< 0.01	NA	NA	NA
Ammonia (as N)	mg/L	NA	NA	NA	NA	1.9	1.8	NA	NA	NA
Chloride	mg/L	42.0	6.0	NA	43.3	37.0	11.0	30.7-53.2	4.2-9.0	NA
Fluoride	mg/L	NA	NA	NA	0.4	< 0.1	< 0.1	0.1-0.2	0.2	NA
Sulfate	mg/L	0.3	0.6	NA	<4.0	<1.0	<1.0	< 0.014	< 0.014	NA
Silica (as SiO <sub>2</sub> )	mg/L	NA	NA	NA	44.9	41.0	42.4	NA	NA	NA
Orthophosphate	mg/L	NA	NA	NA	0.8	< 0.06	< 0.06	NA	NA	NA
As (total)	μg/L	18.0	24.0	19.0	22.0	33.6	35.9	17.0-33.0	25.0-37.0	NA
As (soluble)	μg/L	NA	NA	NA	NA	33.1	35.8	NA	NA	NA
As (particulate)	μg/L	NA	NA	NA	NA	0.5	0.1	NA	NA	NA
As(III)	μg/L	NA	NA	NA	NA	32.8	34.6	NA	NA	NA
As(V)	μg/L	NA	NA	NA	NA	0.3	1.2	NA	NA	NA
Fe (total)	μg/L	1,840	1,630	70	2,520	2,136	1,999	2,020-2,530	1,910-2,240	NA
Fe (soluble)	μg/L	NA	NA	NA	NA	2,140	2,004	NA	NA	NA
Mn (total)	μg/L	110	100	NA	140	133	120	120-150	120-140	NA
Mn (soluble)	μg/L	NA	NA	NA	NA	133	125	NA	NA	NA
U (total)	μg/L	NA	NA	NA	NA	< 0.1	< 0.1	NA	NA	NA
U (soluble)	μg/L	NA	NA	NA	NA	< 0.1	< 0.1	NA	NA	NA
V (total)	μg/L	NA	NA	NA	NA	1.7	0.5	NA	NA	NA
V (soluble)	μg/L	NA	NA	NA	NA	0.6	0.7	NA	NA	NA
Pb (total)	μg/L	NA	NA	NA	NA	NA	NA	NA	NA	<1-3
Cu (total)	μg/L	NA	NA	NA	NA	NA	NA	<5	<5	<5-1,400
Na (total)	mg/L	27.0	15.0	113.0	33.0	41.7	25.0	3.6-36.9	0.5-23.1	NA
Ca (total)	mg/L	NA	NA	NA	78.5	78.5	73.0	NA	NA	NA
Mg (total)	mg/L	NA	NA	NA	23	29.0	27.1	NA	NA	NA

<sup>(</sup>a) as CaCO<sub>3</sub>.

DO = dissolved oxygen; NA = not analyzed; LDHH/OPH = Louisiana Department of Health and Hospitals/Office of Public Health; ORP = oxidation-reduction potential; TDS = total dissolved solids; TOC = total organic carbon

Arsenic. Total arsenic concentrations in source water ranged from 17.0 to 37.0  $\mu$ g/L. Based on the November 3, 2004 sampling results, 98% (32.8 out of 33.6  $\mu$ g/L for Well No. 1) and 96% (34.6 out of 35.9  $\mu$ g/L for Well No. 2) existed as soluble As(III) with the balance made up of soluble As(V). A negligible amount of particulate arsenic also existed in source water. Thus, the proposed treatment process required the injection of KMnO<sub>4</sub> for the oxidation of soluble As(III) to soluble As(V) and subsequent adsorption and co-precipitation of soluble As(V) onto/with iron solids.

**Iron.** Iron concentrations measured in source water ranged from 1630 to 2530  $\mu$ g/L, which exceeded the secondary maximum contaminant level (SMCL) of 300  $\mu$ g/L. Typically, the soluble iron concentration

<sup>(</sup>b) as PO<sub>4</sub>

should be at least 20 times the soluble arsenic concentration for effective arsenic removal via adsorption and co-precipitation with iron solids (Sorg, 2002). Based on the data shown in Table 4-1, natural soluble iron levels were approximately 60 times the soluble arsenic levels in source water, indicating that there would be no need to supplement the natural iron levels for effective arsenic removal.

Manganese. Total manganese levels in source water ranged from 100 to 150  $\mu$ g/L, which exceeded the 50- $\mu$ g/L SMCL for manganese. Of the total manganese present in source water, all of it was in the soluble form, owing to the reducing nature of the source water.

Ammonia. Ammonia concentrations measured in source water ranged from 1.8 to 1.9 mg/L (as N). Due to the presence of ammonia and TOC in source water, Kinetico proposed the use of KMnO<sub>4</sub> to oxidize soluble As(III) to soluble As(V) rather than NaOCl. NaOCl is known to react with ammonia to form chloramines, which is not very effective in oxidizing soluble As(III) (Chen et al., 2009; Ghurye and Clifford, 2001). NaOCl also is known to react with TOC to form disinfection byproducts (DBPs), such as trihalomethanes (THMs) and haloacetic acids (HAA5). However, chloramines most likely will not react with TOC to form DBPs (Bougeard et al, 2010; Amy et al., 1984).

Competing Anions. Silica and phosphate may compete with arsenic for available adsorption sites on iron solids. Silica also may lower the point of zero charge of precipitated iron particles and/or form networks with other adsorbed anions of the same species (Smith and Edwards, 2005; Meng, 2000; Meng, 2002). Typically, silica at levels greater than 40 mg/L and phosphate at levels greater than 1 mg/L may impact arsenic adsorption onto iron particles or iron-based adsorption media. Silica levels in source water were high, ranging from 41.0 mg/l to 44.9 mg/L. Orthophosphate levels in the source water collected by Battelle were less than its MDL of 0.06 mg/L (as PO<sub>4</sub>). However, the data collected by Kinetico showed orthophosphate at 0.8 mg/L (as PO<sub>4</sub>). Orthophosphate levels were monitored over the course of the demonstration study to determine if they were significant enough to have an effect on the arsenic removal process.

Other Water Quality Parameters. pH values of source water samples ranged between 7.0 and 7.3. DO levels were low at 0.4 to 0.7 mg/L and ORP readings ranged from -101 mV to -105 mV, suggesting reducing conditions for the well water, which explained the metals speciation results. Source water had high alkalinity and hardness, which measured between 298 and 313 mg/L and between 173 and 316 mg/L, respectively. Total dissolved solids (TDS) levels ranged from 336 to 416 mg/L. Fluoride concentrations ranged from <0.1 to 0.4 mg/L, well below the MCL of 4 mg/L. Chloride, nitrate, and nitrite were all below their respective SMCLs. Source water also was sampled by the LDHH/OPH for antimony, barium, beryllium, cadmium, chromium, mercury, nickel, selenium, silver, thallium, and zinc. Concentrations of these metals were all below their respective MCLs or SMCLs, and were typically less than their MDLs.

## **4.2** Treatment Process Description

The treatment process at Arnaudville, LA consisted of oxidation of soluble As(III) and soluble Fe(II) using KMnO<sub>4</sub>, adsorption/coprecipitation of soluble As(V) onto/with iron solids, and Macrolite<sup>®</sup> pressure filtration to remove arsenic-laden particles. The pre-existing aeralater was "emptied" and used as a contact tank in front of the Macrolite<sup>®</sup> pressure filters. (Because the aeration feature of the aeralater was not completely removed and because of repeated miscommunications between the operator and the project team concerning this fact, the aeralater continued to be used as an aerator during most of the performance evaluation study. As a result, the system failed to consistently remove arsenic to less than the 10-µg/L MCL despite repeated attempts to troubleshoot this during the study period.) The pre-existing pressure filter (120-in  $\times$  92-in) was emptied and converted to a softener after the Macrolite<sup>®</sup> filters.

Macrolite<sup>®</sup>, a ceramic media manufactured by Kinetico, was approved for use in drinking water applications under NSF International (NSF) Standard 61. The spherical, low density and chemically inert media were designed to allow for filtration rates up to 10 gpm/ft<sup>2</sup>. The physical properties of the media are summarized in Table 4-2.

Table 4-2. Properties of 40/60 Mesh Macrolite® Media

Property	Value
Color	Variable
Sphere Size Range (mm)	23–36
Bulk Density (g/mL)	0.86
Specific Gravity	2.05
Collapse Strength (for 30/50 mesh) (psi)	7,000 to 8,000

Figure 4-7 is a schematic of the installed Macrolite<sup>®</sup> FM-284-AS arsenic removal system. The treatment system consisted of two chemical feed systems for KMnO<sub>4</sub> addition at both wellheads, a pre-existing aeralater to provide contact time, two pressure vessels with hub and lateral stainless steel underdrains, and associated instrumentation. The treatment system also was equipped with a central control panel that housed a touch screen operator interface panel (OIP), a programmable logic controller (PLC), a modem, and an uninterruptible power supply (UPS). The control panel was connected to various instruments used to track system performance including inlet and outlet pressure for each filter, system flowrate, and backwash flowrate and turbidity. All plumbing for the system was schedule 80 PVC and the skidded units were pre-plumbed with the necessary isolation valves, check valves, sampling ports, and other features. A 15-hp, 120-gal air compressor was provided with the system for air sparging of the media during the backwash cycle. Table 4-3 specifies the key system design parameters of the treatment system.

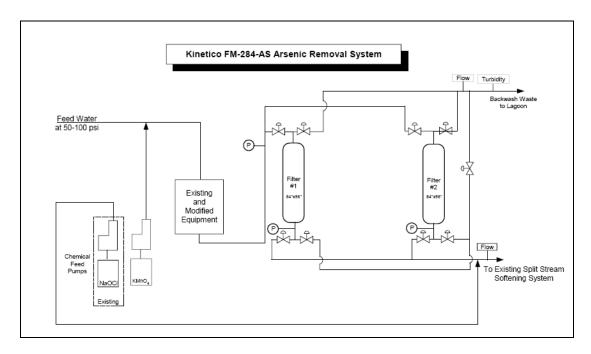


Figure 4-7. Schematic of Kinetico's Macrolite® Arsenic Removal System

Table 4-3. Design Features of Macrolite® System

Parameter	Value	Remarks							
KMnO <sub>4</sub> dosage (mg/L)	2.6	-							
Contact									
No. of Vessel	1	_							
Vessel Size (ft)	$11 D \times 7 H$	5,000 gal capacity							
Contact Time (min)	6.5	_							
Filtration									
No. of Vessels	2	_							
Configuration	Parallel	_							
Vessel Size (in)	84 D × 96 H	_							
Vessel Cross-sectional Area (ft²)	38.5	_							
Media Volume (ft <sup>3</sup> /vessel)	75	24-in bed depth of Macrolite®							
Hydraulic Loading Rate (gpm/ft <sup>2</sup> )	10	385 gpm/vessel							
Backwash									
Pressure Drop (psi)	10-12 <sup>(a)</sup>	Across a clean bed							
Initiating Pressure (psi)	20 <sup>(a)</sup>	Across bed at end of filter run							
Initiating Standby Time (hr)	48 <sup>(a)</sup>	_							
Initiating Service Time (hr)	24 <sup>(a)</sup>	_							
Hydraulic Loading Rate (gpm/ft²)	8–10	308 to 385 gpm/vessel							
Duration (min/vessel)	Variable <sup>(a)</sup>	Based on minimum and maximum							
		backwash time, pressure and turbidity							
		setpoints							
Turbidity Set point (NTU)	20 <sup>(a)</sup>	To terminate backwash							
Wastewater Production (gpd)	Variable <sup>(a)</sup>	Based on PLC set points shown above							
Design Specifications									
Peak Flowrate (gpm)	770	_							
Maximum Daily Production (gpd)	1,108,800	Based on peak flow, 24 hr/day							
Hydraulic Utilization (%)	36%	Estimate based on maximum							
		demand <sup>(b)</sup>							

<sup>(</sup>a) Initial expected values of PLC.

The treatment technology includes the following major process steps and system components:

- Intake Raw water was pumped from both Wells No. 1 and No. 2 to provide a design flowrate of 770 gpm against a 90-psi head. After combined, raw water from both wells flow through a 6-in intake pipe (see Figure 4-8) to a 6-in standpipe inside the aeralater.
- Oxidation Two KMnO<sub>4</sub> feed systems were used to oxidize soluble As(III) to soluble As(V) and soluble Fe(II) to Fe(III) solids. Prior to the study, the KMnO<sub>4</sub> demand was estimated to be 2.6 mg/L, which was delivered by one 0.42-gal/hr (gph) LMI (A171-155S) and one 0.58-gph LMI (P141-352SI) metering pumps (Figure 4-9) to Wells No. 1 and No. 2 wellheads (see an injection point at wellhead in Figure 4-10). Each chemical feed system also included an impeller/mixer and a 66-gal polyethylene storage tank in a secondary containment (Figure 4-11). KMnO<sub>4</sub> was selected because of the elevated ammonia levels (up to 2 mg/L), which were expected to form chloramines upon chlorine addition. Chloramines would result in incomplete oxidation of soluble As(III) to soluble As(V). KMnO<sub>4</sub> system operations were tracked by measuring KMnO<sub>4</sub> consumption in the storage tank.

<sup>(</sup>b) Based on a peak daily demand of 400,000 gpd.



Figure 4-8. Intake Piping to Aeralater

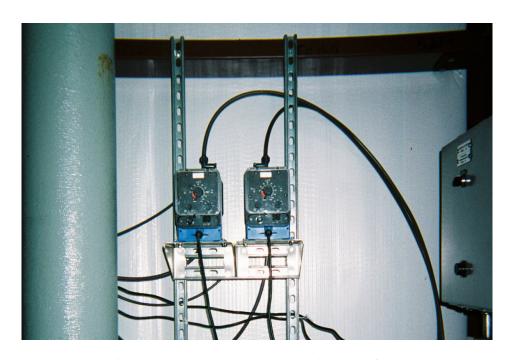


Figure 4-9. Chemical Metering Pumps for KMnO<sub>4</sub> Addition



Figure 4-10. KMnO<sub>4</sub> Injection Point at Wellhead



Figure 4-11. Chemical Storage Tanks and Secondary Containments

• Retention – After KMnO<sub>4</sub> addition, water flowed through the 6-in standpipe before being discharged at the top of the aeralater. The original system design called for the use of the aeralater as a contact tank (not as an aeration unit), which, with its 5,000-gal volume, would

provide approximately 6.5 min of contact time to presumably improve the formation of iron flocs prior to pressure filtration.

Inconsistent to what was planned, the aeralater was used as an aerator during a large part of the performance evaluation study. At system startup, the blower at the top of the aeralater was allowed to operate, causing significant biofouling in the Macrolite<sup>®</sup> filters due to biological activities. The blower was turned off in March 2007, but some aeration apparently continued as water discharged from the standpipe splashed downward through a series of aluminum trays at the top section of the aeralater. In July 2009, the aluminum trays were removed and the 6-in standpipe was cut 4-ft below the high-level sensor in the aeralater. Even with these changes, aeration continued until the aeralater was completely bypassed in March 2010 as discussed in Section 4.5.2.2.

• Pressure Filtration – Removal of arsenic-laden iron particles from the aeralater was achieved via downflow filtration through two 84-in × 96-in pressure vessels. The steel vessels were floor mounted, arranged in parallel, and piped to a valve rack mounted on a welded, stainless steel frame (Figure 4-12). Each vessel contained approximately 24 in (or 75 ft³) of 40/60 mesh Macrolite® media supported by fine garnet underbedding filled to 1 in above a stainless steel wedge-wire underdrain with 0.006-in slots. The steel vessels were coated on the exterior with an epoxy base and the interior was coated with a NSF-approved epoxy coating. The downflow through each vessel was regulated to 385 gpm with a flow-limiting device to prevent filter overrun or damage to the system. The normal system operation with both vessels online provided a total system flowrate of 770 gpm.



Figure 4-12. Macrolite Pressure Filters and Valve Rack (Before Completion of Enclosure)

drop across a clean Macrolite<sup>®</sup> filter was 10 to 12 psi in the service mode. When the pressure drop across a filter reached 20 psi, both filters were automatically backwashed in an upflow configuration. Backwash also might be triggered by the length of time the filters had been in service and/or in stand-by mode. During a backwash cycle, one filter was backwashed while the other was still in service. Water was drained from the first filtration vessel, which was then sparged with air. After a brief settling period, the filtration vessel was backwashed with treated water until the turbidity of backwash wastewater reached a desired setpoint, as measured by an inline Hach<sup>TM</sup> turbidimeter. The filtration vessel underwent a filter-to-waste cycle before returning to feed service, and then the second filter was backwashed. The backwash wastewater was sent to a sump that emptied by gravity into a pond (Figure 4-13) located just outside of the treatment plant building.



Figure 4-13. Backwash Wastewater Pond with Storage Tank in Background

- Softening and Post-Chlorination Approximately 70% of the treated water from the Macrolite® filter was fed into the pre-existing water softener. Synthetic zeolite was used to remove hardness from the water and the softened water was subsequently blended with the approximately 30% of the bypass water. The pre-existing pressure filter (120-in × 92-in) was emptied and converted to a softener. After softening, post-chlorination occurred and the water was transferred to the 127,000-gal storage tank for distribution.
- Storage and Distribution Treated water in the 127,000-gal storage tank was transferred by two high service pumps to the 10,000-gal horizontal hydropneumatic tank before entering the distribution system. On/off of the pumps was controlled by a set of high- and low-level sensors in the hydropneumatic tank.

### 4.3 System Installation

Kinetico completed installation and shakedown of the system on June 23, 2006. The following briefly summarizes system/building installation activities, including permitting, building preparation, system offloading, installation, shakedown, and startup.

- **4.3.1 Permitting.** Design drawings and a process description of the proposed treatment system were submitted on August 19, 2005, by William Jarrell, P.E. of Morgan Goudeau and Associates to LADHH/OPH. LDHH/OPH issued the permit with a letter of no objections on September 16, 2005. Due to elevated As(V) levels in the filter effluent, a permit modification also prepared by William Jarrell, P.E. was submitted on June 21, 2007, and granted on August 8, 2007 for the use of FeCl<sub>3</sub> addition.
- **4.3.2 Building Construction.** Building construction began on March 6, 2006, utilizing a preengineered metal building extension to house the filtration and softener vessels. A 6-in thick concrete pad was installed from March 6 to 27, 2006, and after allowing time for the concrete pad to cure, a go-ahead was given to the vendor to ship the equipment. Upon arrival on April 10, 2006, the filtration vessels and pipe rack were placed on the concrete pad followed by completion of the building enclosure. The building was 53 ft × 25 ft with a roof height of 16 ft. A 12-ft-wide by 14-ft tall overhead door enabled access to the building. Wastewater discharge was through a 12-in PVC drain line that emptied by gravity from a sump into a 4-ft deep pond (Figure 4-13). Figure 4-14 shows the pre-engineered metal building extension that housed the treatment system, which was placed adjacent to the existing aeralater unit.



Figure 4-14. New Building Constructed Adjacent to Pre-existing Aeralater

**4.3.3 System Installation, Startup, and Shakedown**. Upon arrival of the system components, Kinetico, through its subcontractor Twico, performed off-loading, placement of the filter vessels and pipe rack onto the concrete pad, and piping modifications (Figures 4-15 and 4-16). Further system installation work was temporarily halted so that building construction could proceed around the system. Kinetico



Figure 4-15. Off-Loading of Pipe Rack for Macrolite® Filtration System



Figure 4-16. Placement of Vessels and Pipe Rack on Concrete Pad Prior to Building Construction

returned to the site from May 22, 2006, to June 7, 2006, to complete installation and shakedown activities, including inlet and distribution piping tie-ins, electrical interlocking, PLC testing, instrument calibration, and media loading and backwashing to remove fines. The system (Figure 4-17) was manually started up on June 7, 2006, to test the pressure filters. Automatic startup was not performed at the time because of several outstanding issues related to the conversion of the pre-existing aeralater to a contact tank (e.g. filter media removal, cleaning, disinfection, as well as chemical feed point and bypass line installation). After United Water Systems addressed these action items, Kinetico returned to the site to continue shakedown activities during the week of June 19, 2006. Operator training occurred on June 22, 2006. The system was started in automatic mode on June 23, 2006.

Battelle performed system inspections and operator training on sample and data collection from August 9 to 11, 2006. As a result of the system inspections, several punch-list items were identified. Table 4-4 summarizes the items identified and corrective actions taken.



Figure 4-17. Completed Treatment Systems

**4.3.4 Iron Addition Modification.** A permit modification for an iron addition system was prepared by William Jarrell, P.E. and submitted to LADHH/OPH on June 21, 2007, because of higher-than-MCL levels of arsenic in the filter effluent. Approval for iron addition was granted by LADHH/OPH on August 8, 2007, and iron addition was initiated by the operator on December 12, 2007.

Table 4-4. System Inspection Punch-List Items from August 9 to 11, 2006, Site Visit

Item No.	Description	Corrective Action(s) Taken	Resolution Date
1	Move KMnO <sub>4</sub> injection to a single point just prior to aeralater	Action item for Kinetico removed on 11/14/06 due to proposed switch to pre-chlorination	11/14/06
2	Change scale of outlet pressure gauge (PI-5) to a 30 psi max range for better reading accuracy	A 0 to 30 psi pressure gauge shipped and installed by operator	01/15/07
3	Determine cause(s) of 2 to 4 psi discrepancies observed between manual gauges and pressure transducers and take necessary measures to fix problems	Manual gauges next to transducers PT2 and PT3 replaced by Kinetico; confirmed with operator that these manual gauges were working and within 1 to 2 psi of pressure transducer (PT2/PT3) readings	12/13/06
4	Determine cause(s) of different backwash flowrate readings observed between PLC panel and digital readouts on meter; perform meter calibration if needed	11/27/06	
5	Adjust backwash flowrates to within design specifications; elevated backwash flowrate at 400 gpm (or 10.4 gpm/ft²) observed, which might result in media loss based on observations at other arsenic demonstration sites	Backwash flowrate lowered by Kinetico to approximately 380 gpm (inside range of design values of 308 to 385 gpm/vessel [or 8 to 10 gpm/ft <sup>2</sup> ])	11/28/06
6	Determine cause(s) of system warning light on Hach Turbidimeter, which was lit up on the instrument readout panel during system operation	Hach warning light cleared	11/27/06
7	Determine cause(s) of low flow alarms during backwash, which caused backwash to fail and system to go out of service. Problems reported by operator to Kinetico on August 15, 2006; operator had to acknowledge the alarm and manually backwash system prior to returning to service	Alarm was due to a bad solenoid valve on air bank; lack of backwash flow due to valve not opening. A spare solenoid on the panel was used to fix the valve in question	08/31/06
9	Determine if a flow restrictor should be installed to regulate fast rinse flowrate to ensure proper fast rinse operation; flow restrictors only installed on service line	An orifice plate to control fast rinse flow rate shipped on October 20, 2006, and installed by Kinetico later. Fast rinse flowrate controlled to be within design specification at 280 gpm	11/27/06
10	Determine cause(s) of elevated arsenic levels in filter effluent. On 09/28/06, Kinetico was notified by Battelle that filter effluent was not reaching below 10 µg/L arsenic due to presence of elevated soluble As(V) concentrations	Iron addition initiated on December 12, 2007, but with little improvement; arsenic levels in filter effluent remained elevated for the duration of study	Not resolved

### 4.4 System Operation

The treatment process as designed would consist of oxidation of soluble As(III) and soluble Fe(II) using KMnO<sub>4</sub>, adsorption/co-precipitation of soluble As(V) onto iron solids, and Macrolite<sup>®</sup> pressure filtration for removal of arsenic-laden iron particles. The existing aeralater would be emptied of all internal components and used as a contact tank upstream of the Macrolite<sup>®</sup> pressure filters. The existing pressure filter would be converted to a softener in its pre-study configuration for hardness removal.

Upon completion of system installation in July 2006, the project team believed that the aeralater had been properly modified to function as a contact tank. It was not until late 2006 and early 2007 when the project team discovered that the aeralater, in fact, had been functioning as an aerator, causing extensive biofouling of the filter media due to microbial activities, including nitrification. Accumulation of biosolids in the filters significantly increased backwash frequency (from one or two times/day to as many as eight times/day). Efforts to rectify the problems included an acid and a caustic wash of the fouled media in December 2006 and turning off the blower to stop air flow to and aeration in the aeralater in March 2007. To better control biological growth in the filters, both KMnO<sub>4</sub> and chlorine (in gas form) were used in late January 2007 and then only chlorine (in gas form) in March 2007 (exacting timing for KMnO<sub>4</sub>/chlorine and chlorine usage could not be verified). While these changes appeared to alleviate, to some extent, frequent backwash issues, filter effluent continued to contain >10 μg/L of arsenic, existing mostly as soluble As(V), during most sampling events. This prompted a decision to add supplemental iron to raw water, starting on December 12, 2007, to aid in the adsorption/co-precipitation process.

The effect of iron addition was inconclusive due to erratic FeCl<sub>3</sub> dosage caused by problems with the chemical feed pump and corrosion and dissolution of the mixing equipment within the day tank. As a result, iron addition not only did not significantly reduce soluble arsenic concentrations, but also added extra solids loading to the pressure filters, resulting in even more frequent backwash. This, along with the fact that piping in the aeralater was modified in July 2009 to minimize aeration of source water in the aeralater, led to the termination of supplemental iron addition in July 2009. Because system performance did not appear to improve, the filter media were acid-washed three times in March, July, and October 2009. Meanwhile, the two flow restrictors located downstream of the filters were unclogged and rubber grommets in the restrictors removed to enhance water flow through the filters (from ~250 to ~450 gpm).

While the system continued to produce effluent with elevated arsenic and iron concentrations, two members of the project team visited the site from January 18 through 22, 2010, to inspect the system and conduct three separate, yet connected tests relating to the performance of and potential future modifications to the system. The tests performed included sampling at the AC sampling location after physical bypass of the aeralater, a series of jar tests relating to oxidant selection and optimal oxidant dose, and a filter run length study to determine useful run length between two consecutive backwash events. The test results led to two recommendations by the project team to permanently bypass the aeralater to minimize aeration prior to the pressure filters and to return to the use of KMnO<sub>4</sub> as the oxidant for soluble As(III) and soluble Fe(II) oxidation.

During a following trip from March 17 through 19, 2010, made by Accurate Water Solutions under contract with Battelle, it was noted that the facility had gone ahead to install piping to bypass the aeralater (Figure 4-18). Upon its inspections, Accurate Water Solutions reported, among other issues, potential water hammer problems. After replenishing the filter beds with Macrolite<sup>®</sup> media, the facility began to operate the system with KMnO<sub>4</sub> and performed another acid wash to both filters thereafter in April 2010. A pipe break (Figure 4-19) took place on May 5, 2010, and forced the system to be shut down until May 20, 2010. Soon after the system resumed operation, the facility was issued an administrative order by LDHH/OPH on June 2, 2010 due to exceedance of running annual average of arsenic compliance samples collected during October 1, 2008, through September 30, 2009.



Figure 4-18. Piping Bypassing Pre-existing Aeralater



Figure 4-19. Replacement Steel Pipe (Vertical Section on Right) After Pipe Break

The two project team members returned to the site again during July 26 through 31, 2010 to perform two run length tests with the use of bypass piping and KMnO<sub>4</sub>. While soluble As(V) concentrations were reduced as anticipated, total arsenic concentrations were at or just over the 10-µg/L MCL. In addition, iron broke though the pressure filters within 2 hr of filter runs. A follow-on meeting was convened at EPA National Risk Management Research Laboratory (NRMRL) on September 16, 2010, with representatives from EPA, United Water Systems, and Battelle in attendance. Recommendations were made by meeting attendees to the facility operator concerning ways to verify his observations that the system had produced effluent with arsenic concentrations below the MCL. A decision also was made to immediately end the performance evaluation study due to expiration of the Round 2 demonstration contract between EPA and Battelle. Table 4-5 chronologically summarizes key events that took place during the performance evaluation study.

Table 4-5. Key Events During Performance Evaluation Study at Arnaudville, LA

Date	Problems Encountered	Actions Taken
10/10/06	Higher than MCL levels of soluble As(V) in	Kinetico agreed to include iron addition to
	filter effluent observed since start of study	system
11/06	System experienced increasing backwash	
	frequency (from 2 to 3 times/day to 2 to 8	
	times/day)	
12/04/06	Battelle informed by Kinetico possible	
	media fouling observed during its site visit	
	in late November 2006	
12/08-		Operator performed an acid and a caustic
12/06		wash on Macrolite® pressure filters; backwash
		frequency back to 1 to 2 times/day
Late		Operator began to use gas chlorine for pre-
January–		<b>oxidation</b> (possibly also with the use of some
02/19/07		KMnO <sub>4</sub> )
02/21/07		Battelle met with Kinetico and EPA to discuss
		operational issues; nitrification determined as
		cause for biofouling. Measures recommended
		included:
		Stop aeration in aeralater
		<ul> <li>Apply chlorine shock to filter media</li> </ul>
		periodically
		Chlorinate raw water and/or backwash water
03/08/07		Operator turned off aeralater blower
03/19/07		Battelle placed a P.O. with Morgan Goudeau
		and Assoc. for preparation of an iron addition
		submittal package for LADHH
04/10/07	Battelle informed Kinetico of decreased	Kinetico shipped media to facility on 04/26/07
	filter bed depths (4.0 to 7.5 in)	to top off filter beds
04/18/07		Temporarily suspended regular weekly sampling
		due to on-going operational issues
08/08/07		Received approval from LADHH for iron
		addition
09/24/07-		Operator replenished 7.5-in media into Vessel A
10/15/07		and 4-in media into Vessel B; system taken
		offline
11/05/07		Resumed normal system operation

Table 4-5. Key Events During Performance Evaluation Study at Arnaudville, LA (Continued)

Date	Problems Encountered	Actions Taken
11/19/07		Operator conducted a 3.2-hr run length study; arsenic at 11.4 to 12.9 µg/L measured in filter effluent with no particulate iron breakthrough
12/12/07		<b>Began supplemental iron addition</b> (EPA TOM visited site on 12/11/07)
01/23/08		Resumed weekly sampling; results indicated similar treatment results as compared to no iron addition
02/08-		Increased iron dosage from ~0.5 to 1.2 mg/L (as
04/08		Fe); total arsenic level reduced to 5.6 μg/L Operator conducted a run length study; results
		indicated insufficient chlorine addition during testing (i.e., no arsenic oxidation/co-precipitation/removal occurred)
06/08– 09/08	Impeller/mixer corroded, leading to stratification within day tank and inconsistent chemical dosing	Battelle attempted to contact operator regarding need to repeat special study; operator indicated in 09/08 that mixing unit was down and that he would repeat the study once a new mixing unit was installed
10/20/08		Operator repeated run length study; results indicated that ion dose rates were too low
11/08- 12/08		Operator worked on iron dose rates, which were either too low or too high; mixing equipment continued to be corroded/dissolved
01/09– 05/09	System flowrate gradually reduced to 250 gpm	Battelle attempted to contact operator regarding status of mixing unit and another acid wash, which was carried out in early March; Battelle purchased a new pump and an impeller/mixer for FeCl <sub>3</sub> mixing; operator called on 05/14/09 indicating receipt of new mixing equipment and low system flowrate (250 gpm)
06/29/09		Operator informed Battelle that aeration continued in aeralater; Battelle emphasized that aeration must be stopped and that iron addition can be discontinued once aeration is stopped
07/13- 20/09		Performed acid wash on media; aluminum trays in aeralater removed and standpipe in aeralater cut approximately 4 ft below high level sensor (explained to Battelle during site visit for jar tests in 01/10)
09/09- 10/09	System continued to experience low flowrate	
10/26– 28/09		Performed acid wash on media; little improvement on flowrate; identified cause to be a clog in flow restrictors; worked with Kinetico to unclog flow restrictors (by removing sediment and rubber grommets); restored flowrate to ~450 gpm
11/09- 01/10	System continued to have early iron and arsenic breakthrough	

Table 4-5. Key Events During Performance Evaluation Study at Arnaudville, LA (Continued)

Date	Problems Encountered	Actions Taken
01/18-		Battelle onsite to perform jar tests, realizing
22/10		that:
		• Aeration in aeralater continued (2 to 4 mg/L of DO at AC)
		System settings significantly deviated from
		design settings
		Media beds needed replenishment Jar test
		results indicated that:
		• Without air, soluble As(V) reduced down to ~5 μg/L with use of KMnO <sub>4</sub> , suggesting
		<ul><li>bypassing aeralater could be a solution</li><li>Chlorine would leave higher levels of</li></ul>
		As(III) and Fe(II) at AC
03/17-	Low Δp across vessels (possible	Tom Jadach of Accurate Water Solutions visited
19/10	channeling?)	site to inspect system and observed the
		following:
		Media has bio- and iron fouling; back-to-
		back acid washes using 10% muriatic acid
		needed
		• Media beds are only ~17 in deep; need ~24 ft <sup>3</sup> per vessel
		<ul> <li>Aeralater bypassing piping already installed;</li> </ul>
		had concerns over water hammer
04/14/10		24 ft <sup>3</sup> media ordered by Battelle (another 24 ft <sup>3</sup>
		ordered by United Water Systems)
04/19/10		Operator indicated the following:
		Both vessels acid washed
		Bypassing plumbing completed  System by a system of the EVM of the system of the
		• System changes made for KMnO <sub>4</sub> injection
05/05-	Pipe break at site; system taken offline	Replacement steel piping installed
20/10	-	
06/02/10	Administrative order issued by LDH	
07/26-		Battelle onsite to perform run length studies
31/10		with use of bypass piping and KMnO <sub>4</sub> :
		• Experienced early iron breakthrough from filters (within 2 hr)
		<ul> <li>Soluble As(V) reduced to about 6 μg/L,</li> </ul>
		consistent with results from jar tests
		Actual backwash steps not following PLC
		settings
09/16/10		Meeting convened at EPA/NRMRL with
		representatives from United Water Systems, EPA, and Battelle:
		Operator indicated that system effluent had low iron concentrations due to use of both      Concentrations
		KMnO <sub>4</sub> and chlorine
		Recommendations provided by meeting participants to operator regards ways to
		verify his claims
		System performance evaluation study to end
		immediately due to end of Round 2 contract between EPA and Battelle

**4.4.1 Service Operation.** The system operational parameters are tabulated and attached as Appendix A with the key parameters summarized in Table 4-6. The performance evaluation study began on July 17, 2006, and ended on September 16, 2010, when the project team met with representative of United Water System at EPA/NRMRL in Cincinnati, OH. The operational parameters were logged only until February 21, 2010. Between July 17, 2006, and February 21, 2010, the system operated for 17,800 (Vessel B) to 18,329 hr (Vessel A) based on two hour meters interlocked with the well pumps. Average daily run times ranged from 4.2 to 23.6 hr/day and averaged 14.0 hr/day for Vessel A and ranged from 4.4 to 23.6 hr/day and averaged 13.9 hr/day for Vessel B. As shown in Figure 4-20, no obvious seasonal variation was observed during the study period.

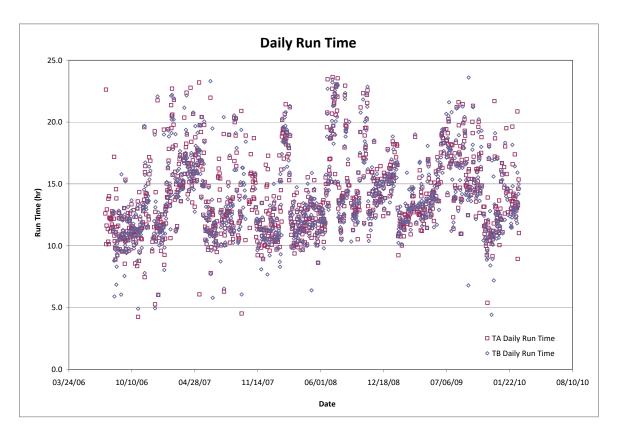


Figure 4-20. Daily Run Time

Daily demands varied between 89,635 and 505,714 gpd and averaged 277,128 gpd, compared to the 280,000 to 380,000 gpd reported by the facility prior to the performance evaluation study. Daily demands were calculated based on incremental readings of a flow meter/totalizer installed at the effluent side of the pressure filters normalized for a 24-hr day. Similar to daily system run times, no obvious seasonal variation was observed during most of the study period. As shown in Figure 4-21, the only clear increasing trend on daily demands appeared to occur during the 2009 summer (before July 2009), but similar increasing trends also were observed during the 2007 to 2008 and 2009 to 2010 winters. At 277,128 gpd, the system operated at 25% of the design capacity (i.e., 770 gpm).

**Table 4-6. Treatment System Operational Parameters** 

Parameter	Value						
Operating Period	07/17/06-09/16/10 <sup>(a)</sup>						
Pretreatment Operation							
KMnO <sub>4</sub> Dosage (mg/L) <sup>(b)</sup>	1.8 [0.04–4.7]						
Chlorine Dosage (mg/L [as Cl <sub>2</sub> ]) <sup>(c)</sup>	NA						
FeCl <sub>3</sub> Dosage (mg/L [as Fe]) <sup>(d)</sup>	NA						
Service Operation							
Total Operating Time (hr)	18,329 (Vessel A)						
	17,800 (Vessel B)						
Daily Operating Time (hr)	14.0 [4.2–23.6] (Vessel A)						
	13.9 [4.4–23.6] (Vessel B)						
System Throughput <sup>(e)</sup> (gal)	363,096,450						
Daily Demand (gal)	277,128 [89,635–505,714]						
Instantaneous Flowrate (gpm)	335 [136–509]						
Calculated Flowrate <sup>(f)</sup> (gpm)	352 [130–673]						
Contact Time in Aeralater <sup>(g)</sup> (min)	14.9 [9.8–36.8]						
Hydraulic Loading over Pressure Filter <sup>(g)</sup> (gpm/ft <sup>2</sup> )	4.4 [1.8–6.6]						
System Inlet Pressure (psi) <sup>(h)</sup>	33.0 [18–48]						
System Outlet Pressure (psi) <sup>(h)</sup>	15.8 [10–30]						
Tank A Outlet Pressure (psi) <sup>(h)</sup>	24.7 [12–44]						
Tank B Outlet Pressure (psi) <sup>(h)</sup>	24.2 [10–44]						
Δp Across System (psi) <sup>(h)</sup>	16.9 [1–42]						
Δp Across Vessel A (psi) <sup>(h)</sup>	7.8 [1–34]						
Δp Across Vessel B (psi) <sup>(h)</sup>	8.1 [1–38]						
Filter Run Time between Backwashes (hr)	3.9 [0–22.6] (Vessel A)						
	3.6 [0–22.5] (Vessel B)						
Backwash Operation							
Backwash Frequency (time/vessel)	2.2 [0–10] (Vessel A)						
	2.3 [0–16] (Vessel B)						
Number of Backwash Cycles (Vessels A/B)	2,876/3,000						
Flowrate <sup>(i)</sup> (gpm)	NA						
Hydraulic Loading Rate <sup>(i)</sup> (gpm/ft <sup>2</sup> )	NA						
Duration (min/tank) <sup>(i)</sup>	NA						
Backwash Volume (gal/vessel)	3,376						
Filter-to-Waste Volume (gal/vessel)	250						
Wastewater Produced (gal/vessel)	724 [596–1,157]						

Note: Data presented included average and [range].

- (a) Operational data recorded since system startup on 07/17/06 through 02/21/10.
- (b) KMnO<sub>4</sub> used from system startup in 07/06 through 02/07 and then from 04/10 through end of performance evaluation study in 09/10; tracking of KMnO<sub>4</sub> performed only during 07/06 through 02/07.
- (c) Gas chlorine used between 02/07 through 04/10; chlorine dosages not tracked.
- (d) FeCl<sub>3</sub> added during 12/07 through 07/09; iron dosages tracked sporadically during testing.
- (e) Estimated based on average instantaneous flowrate (335 gpm) and average filter operating time ([17,800 + 18,329]/2).
- (f) Calculated flowrates based on incremental throughput and incremental operating hours.
- (g) Based on instantaneous flowrate readings.
- (h) After outliers removed.
- (i) Data not available due constant changes of flowrate and other backwash settings on PLC.

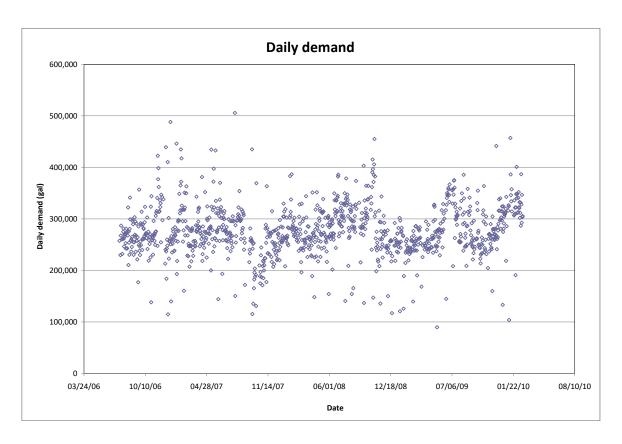


Figure 4-21. Daily Demands During Study Period

System flowrates were tracked by both instantaneous readings of the flow meter and calculated values based on hour meter and flow totalizer readings on the control panel. Instantaneous flowrate readings varied from 136 to 509 gpm and averaged 335 gpm. Calculated flowrate values varied from 130 to 673 gpm and averaged 352 gpm. Although large variations were observed for both instantaneous and calculated flowrates, these flowrate readings/values appeared to agree with one another for the most part as shown in Figure 4-22.

Flowrates during the periods from February 10 through June 5, 2007, from January 29 through February 27, 2008, and from June 20 through August 24, 2008, were significantly reduced to an average of 283, 260, and 250 gpm, respectively, due to failure and/or shutdown of one of the wells caused by various operational issues. Flowrates were gradually reduced from approximately 400 gpm in September 2008 to below 280 gpm by the end of January 2009, and then suddenly increased to over 370 gpm in February 2009. The reason for the sudden increase was an acid wash of the filter media by the operator per Kinetico recommendation. Thereafter, flowrates were gradually decreased again from about 370 gpm to below 270 gpm by October 2009 despite two consecutive acid washes of the filter media in July and October 2009. On October 29, 2009, with Kinetico's assistance, it was determined that the decreasing flowrates were caused by clogged flow restrictors. Upon removal of large flakes of precipitated iron and rubber grommets from the flow restrictors, flowrates were restored to above 400 gpm throughout the remainder of the performance evaluation study.

Using the average instantaneous flowrate of 335 gpm and total number of filter operating time (i.e., average of Vessel A and B operating times –18,065 hr), the total system throughput was estimated to be 363,096,450 gal.

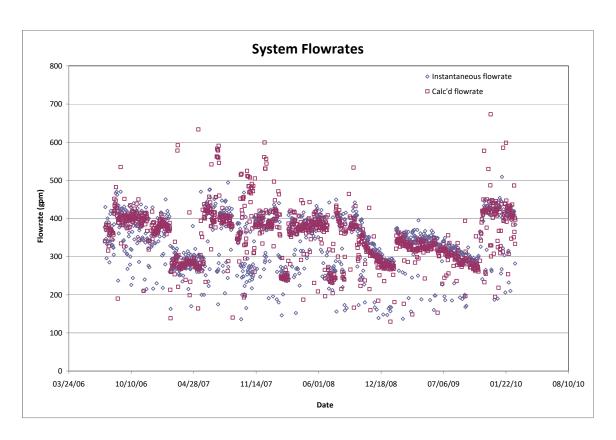


Figure 4-22. System Flowrates

The 335-gpm instantaneous flowrate (on average) corresponded to a contact time of 14.9 min in the aeralater and a filtration rate of 4.4 gpm/ft<sup>2</sup> through the pressure filters. These values were much higher than the design contact time of 6.5 min, but much lower than the design filtration rate of 10 gpm/ft<sup>2</sup>.

As shown in Figure 4-23, system outlet pressure readings stayed relatively constant, ranging from 10 to 30 psi and averaging 15.8 psi. System inlet pressure readings, however, varied significantly, ranging from 18 to 48 psi and averaging 33 psi. Variations observed were caused primarily by factors such as number of wells operating, system flowrate, installation of orifice plates, removal of rubber grommets from the flow restrictors, extent of media fouling, depth of filter media, addition of supplemental iron, and stage of filtration runs (e.g., just before or just after backwash), etc. System differential pressure ( $\Delta p$ ) readings generally varied according to the system inlet pressure readings, ranging from 1.0 to 42 psi and averaging 16.9 psi.

 $\Delta p$  readings across both pressure filters also varied extensively (Figure 4-24), ranging from 1 to 34 psi for Vessel A and from 1 to 38 psi for Vessel B. As shown in the figure,  $\Delta p$  readings generally decreased from the range of 5 to 20 psi at the beginning of the performance evaluation study to the range of 1 to 5 psi by the end of performance evaluation study. Factors contributing to the decreases included primarily washing away of filter media from the pressure filters (note that the pressure filters were replenished with 4 to 7.5 in of media in April 2007 and 7.5 in of media in April 2010) and especially removal of rubber grommets in October 2009. Due to constant changing of PLC settings and other system operating conditions by the operator as mentioned earlier, it was difficult to pinpoint what exactly had happened during system operation and to interpret system performance using the recorded data such as vessel  $\Delta p$  readings.

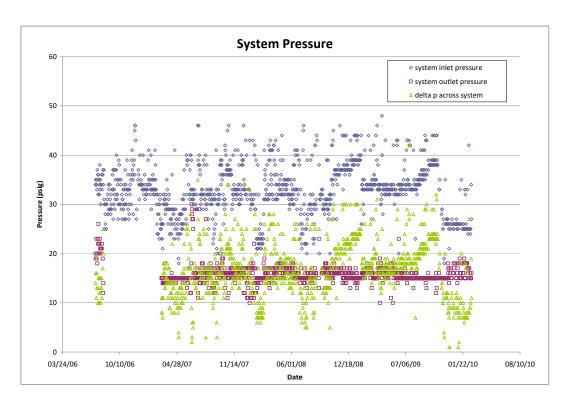


Figure 4-23. System Inlet/Outlet Pressure and Differential Pressure

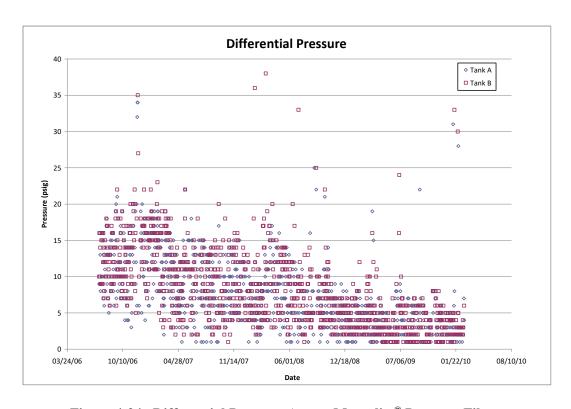


Figure 4-24. Differential Pressure Across Macrolite® Pressure Filters

**4.4.2 KMnO<sub>4</sub>, Chlorine, and Iron Additions.** KMnO<sub>4</sub> was used initially as an oxidant to oxidize soluble As(III) and soluble Fe(II). Due to biofouling in the pressure filters, KMnO<sub>4</sub> was used in conjunction with chlorine in February 2007. In an attempt to more effectively curb biological growth, gas chlorine was used to replace KMnO<sub>4</sub> soon afterwards. Meanwhile, FeCl<sub>3</sub> was added to supplement natural iron for better soluble As(V) removal in December 2007. After it became clear that aeration in fact was the reason for biofouling and ineffective soluble As(V) removal, addition of FeCl<sub>3</sub> was discontinued in July 2009 and KMnO<sub>4</sub> was used again as the oxidant in April 2010.

KMnO<sub>4</sub> dosages were tracked by measuring daily consumption through solution level changes in the chemical day tanks and daily flow based on the system effluent totalizer. Solution levels in both day tanks were measured daily starting on August 16, 2006, for Tank 1 and on September 25, 2006, for Tank 2. Measurements continued through February 13, 2007, when KMnO<sub>4</sub> was replaced with gas chlorine. After KMnO<sub>4</sub> was used again as the oxidant in April 2010, changes of solution levels were not recorded. As shown in Figure 4-25, KMnO<sub>4</sub> dosages ranged from 0.042 to 4.7 mg/L (as KMnO<sub>4</sub>) and averaged 1.8 mg/L (as KMnO<sub>4</sub>). This average dosage was about 30% lower than the target dosage of 2.6 mg/L.

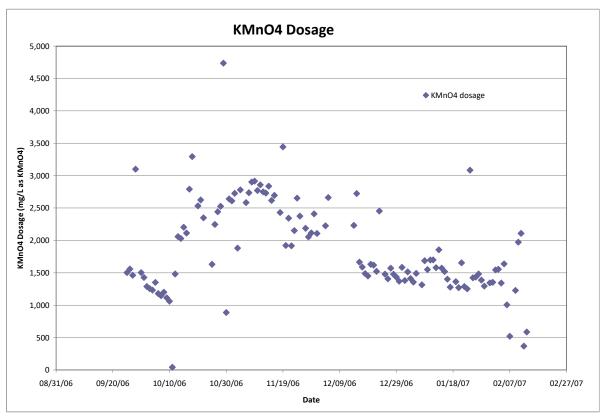


Figure 4-25. KMnO<sub>4</sub> Dosages over Time

KMnO<sub>4</sub> dosages as plotted in Figure 4-25 were compared with ICP-MS results of samples collected at the AC sampling location (after KMnO<sub>4</sub> addition). The amounts of manganese measured by ICP-MS ranged from 1.0 to 2.7 mg/L (as KMnO<sub>4</sub>) and averaged 1.7 mg/L (as KMnO<sub>4</sub>). After adjusted with the average amount of manganese in source water (0.4 mg/L [as KMnO<sub>4</sub>]), the amounts measured due to KMnO<sub>4</sub> addition would be 1.3 mg/L (as KMnO<sub>4</sub>). This amount is 28% lower than the average dosage (1.8 mg/L [as KMnO<sub>4</sub>]) applied to the treatment system.

After switching from KMnO<sub>4</sub> to gas chlorine, chlorine dosages were not tracked. Total chlorine residuals at the AC and TB sampling locations were monitored by the operator using a field Hach meter. Because reporting of the data to Battelle was sporadic and because communications with the operator had been a great challenge, no chlorine usage or residual data could be presented in this report.

Initial sampling results across the treatment train appeared to suggest that there was a need for iron addition in order to reduce arsenic concentrations to below  $10~\mu g/L$  (although it became evident later that poor arsenic removal observed was caused primarily by the aeration process in the aeralater). Upon LADHH's approval, iron addition was implemented in December 2007. According to the plan, iron dosages should have been tracked by measuring daily consumption of FeCl<sub>3</sub> in a day tank and daily flow read from the effluent totalizer. However, tank levels were measured so sporadically (during the period from February 26, 2008, through May 29, 2009) that iron dosages could not be calculated and plotted. Based on the metal analyses as discussed in Section 4.5.1, iron dosages scattered quite extensively, which, among others, might have been caused by an oversized pump and a corroding/dissolving impeller/mixer due to the corrosivity of FeCl<sub>3</sub> solution. By May 2009, a more adequately sized pump and a new impeller and a mixer were installed, but logging of daily consumption did not resume. By July 2009, iron addition was discontinued.

**4.4.3 Backwash Operation.** The two Macrolite<sup>®</sup> pressure filters were backwashed 2,876 and 3,000 times, respectively. Backwash was triggered mainly by a  $\Delta p$  setpoint. Occasionally, manual backwashes were initiated, but only for testing and sampling of backwash water and solids.

After system startup in July 2006, the pressure filters generally were backwashed once or twice a day (see Figure 4-26). The backwash frequency gradually increased to up to eight times a day by late November 2006. Examination of the filter media indicated significant biofouling, apparently caused by microbial activities as a result of aeration in the aeralater. Immediately after an acid and a caustic wash in early December 2006, the backwash frequency was restored to once or twice a day. Thereafter, the backwash frequency was maintained to mostly once or twice a day through 2007. The use of gas chlorine (to replace KMnO<sub>4</sub>) in February 2007 and shutting-off of the blower (in the aeralater) in March 2007 apparently helped slow down the biofouling. The acid and caustic wash is discussed in details in Section 4.4.3.2.

Starting from December 2007, iron was added to well water; the backwash frequency increased correspondingly to mostly one to three times a day. Occasionally, the backwash frequency spiked to six or even seven to 16 times a day. By January and February 2009, the backwash frequency increased rather consistently to six to 11 times a day and system flowrates decreased to about 280 gpm. Bio- and iron-fouling were believed to be the main reason for more frequent backwashing. Under Kinetico's instructions, the operator performed the second acid wash to the filter media in early March 2009. Upon completion, the backwash frequency was reduced to mostly three to four times per day, which was somewhat higher than those experienced with iron addition in 2008.

Due to deteriorating flow through the pressure filters after the March 2009 acid wash (from 350 to 270 gpm by October 2009), two additional acid washes were performed in mid-July and late October 2009. These acid washes appeared to be less effective in reducing the backwash frequency and restoring the system flowrates.

The backwash duration for each tank was affected by the minimum and maximum backwash time settings and the ability of the backwash water to meet the turbidity threshold setting as measured by an inline  $\operatorname{Hach}^{\mathsf{TM}}$  turbidimeter. If the backwash water failed to meet the set threshold prior to reaching the maximum backwash time, the backwash failure alarm had to be acknowledged and a successful backwash cycle had to be conducted before the tank could return to the service mode. Backwash was followed by a

# No. of Backwashes/day from August 2006 Through August 2008

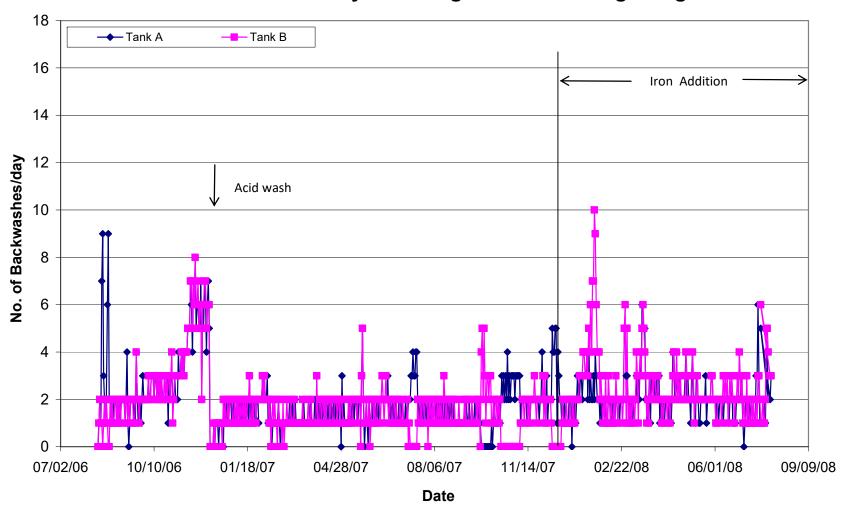


Figure 4-26. Backwash Frequency

## No. of Backwashes/day from August 2008 Through February 2010

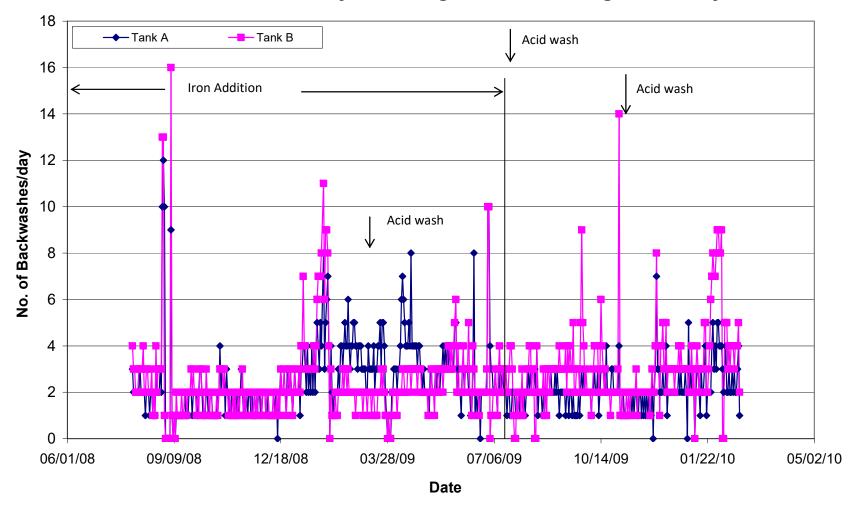


Figure 4-26. Backwash Frequency (Continued)

filter-to-waste step to remove any particulates from the filter. The amount of wastewater produced totaled 19,834,500 gal (or 3,376 gal/vessel), equivalent to 5.5% of the total amount of water treated. This waste to production ratio is significantly higher than those of several similar Macrolite® pressure filtration systems evaluated at other EPA arsenic removal demonstration sites (see Table 4-7). Media fouling and resulting higher backwash frequency apparently contributed to the higher backwash water usage.

Design Waste to System Vessel Production **Flowrate** No. of Size Ratio Site Vessels References (gpm) (in) (%)  $84 \times 96$ Arnaudville, LA 770 2 5.5 Pentwater, MI 400 2 60 × 96 1.9 Valigore et al., 2008 Felton, DE 375 3  $48 \times 72$ 1.5 Chen et al., 2010b Sabin, MN 250 2  $48 \times 72$ 2.5 Chen et al., 2010a

 $36 \times 72$ 

1.9 - 2.4

Condit and Chen, 2006

Table 4-7. Waste to Production Ratios for Macrolite® Pressure Filters

Assuming a backwash flowrate of 385 gpm, the backwash duration would be 8.8 min. During the performance evaluation study, however, backwash flowrates and other backwash settings were frequently changed by the operator. This, in conjunction with the fact that the inline turbidimeter was not functioning properly during most of system operation, prevented a meaningful estimate of the backwash duration during the study period.

Climax

140

Because of frequent backwashes, filter run times between two consecutive backwashes were short, averaging 3.9 and 3.6 hr for Vessels A and B, respectively. Varying system operating conditions caused filter run times to vary significantly from 0 to 22.6 hr and from 0 to 22.5 hr, for Vessels A and B, respectively.

4.4.3.1 PLC Settings. Table 4-8 presents the PLC backwash settings at system startup on August 10, 2006, and during a site visit on January 18, 2010. One of the most visible discrepancies was the  $\Delta p$  trigger, which was set at 3 psi for both tanks. According to the vendor, the expected clean-bed  $\Delta p$  would be 8 to 10 psi and the recommended  $\Delta p$  triggert should be approximately 10 psi larger than the clean-bed  $\Delta p$  (i.e., ~20 psi). The 3-psi  $\Delta p$  trigger could cause the filters to be backwashed far too frequently.

The actual pressure drop across the pressure filters at the time of data recording was 2.0 psi. The low pressure drop observed might have been caused by factors such as shallow filter beds (indicative of media loss), crusty bed surface, and/or channeling. It was determined later during a site visit by Accurate Water Solutions on March 17 and 18, 2010, that the low pressure drop actually was caused by the removal of rubber grommets in the flow restrictors in October 2009. This was supported by observation of a sudden decrease in inlet pressure and  $\Delta p$  (see Figures 4-23 and 4-24), and a sudden increase in system flowrate (see Figure 4-22).

Both minimum and maximum backwash times were set at 6 min; thus, all backwashes were terminated in 6 min. The filter beds most likely were not completely backwashed in 6 min, as evidenced by the large amount of solids still present in backwash wastewater. The turbidimeter apparently was not working properly. For example, the turbidity reading of a backwash wastewater sample taken by the end of a backwash event showed approximately 40 nephelometric turbidity units (NTU) using a Hach handheld

turbidimeter, while the inline turbidimeter read only 5 to 6 NTU. The operator cleaned the turbidimeter with dilute HNO<sub>3</sub>, but the cleaning did not seem to solve the problem.

The backwash flowrate observed was 445 gpm (11.7 gpm/ft²), which was significantly higher than the design value of 310 to 385 gpm (8 to 10 gpm/ft²). High backwash flowrates could lead to loss of media and need to replenish the filter beds. In fact, both filter beds were replenished twice in April 2007 and April 2010. Nonetheless, the 445-gpm flowrate appeared to be insufficient to fluidize the beds based on an observation made by Accurate Water Solutions during its March 2010 visit.

As noted earlier, backwash settings and other system operating conditions were changed constantly by the operator. The changes were not recorded in the field logs or reported to Battelle's Study Lead. Therefore, it was difficult to track system performance and interpret treatment results based on PLC settings and system operating conditions.

**Recorded Date** 08/10/06 01/18/10 Parameter (for Each Tank) Drain Time (min) 4 6 Service Time Trigger (hr) 24 24 Standby Time Trigger (hr) 48 48 Δp Trigger (psi) 20 3 Minimum Backwash Time (min) 5 6 Maximum Backwash Time (min) 16 6

20

200

2

30

200

2

Turbidity Threshold (NTU)

Filter-to-Waste Time (min)

Low Flowrate Threshold (gpm)

Table 4-8. Snapshots of PLC Backwash Settings

4.4.3.2 Acid and/or Caustic Washes. When the high backwash frequency was observed in November 2006, samples of Macrolite® media were collected from both pressure filters and sent to Kinetico for analysis. One aliquot of the media was placed in a column, backwashed at 100% bed expansion to remove suspended solids, and removed from the column for visual observation and photographing (Figure 4-27). One portion was then vacuum-filtered and 1.135 g of the moist media was placed in 36 mL of 1% sulfuric acid and heated to nearly boiling. The solution was then filtered and analyzed for iron, manganese, silica, and phosphorus. The results showed 10.6, 1.7, 2.4, and 2.2 mg/g of media for iron, manganese, silica, and phosphorus, respectively. One aliquot each of the vacuum-filtered media was allowed to soak for approximately 67 hr in 10% HCl, 10% NaOH, saturated NaCl, Liquinox, mineral spirits, and methanol. No significant changes to the media were observed except for the HCl-soaked media, which seemed to be coated in an opaque gelatinous substance (Figure 4-28). After the HCl-soaked media was dried at 105 °C for 1 hr, it exhibited a glazed appearance with some of the gelatinous substance flaking off from the media and attaching to the watch glass (Figure 4-29). Placing the HCl-soaked media in a 20% NaOH appeared to break up the gelatinous coating.

After the laboratory testing, Kinetico recommended to proceed with the acid/caustic washes, but only after it determined that the system components were chemically compatible with the strong acid/base used. A teleconference with the operator on December 8, 2006, however, indicated that the operator had initiated the acid wash. Without recourse, Kinetico agreed to allow the acid to stay in the vessel for 24 hr and the operator performed a system backwash the following morning on December 9, 2006. Because no

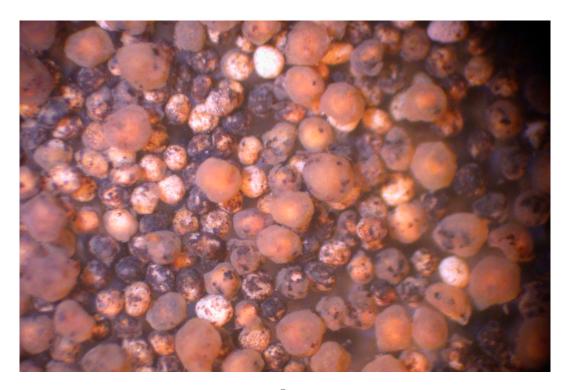


Figure 4-27. Macrolite® Media After Backwash



Figure 4-28. Macrolite® Media After Being Soaked in 10% HCl Solution

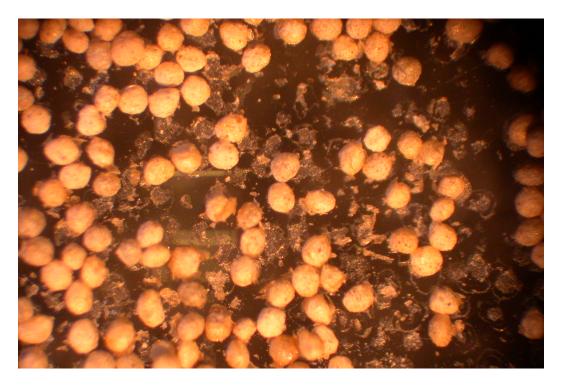


Figure 4-29. HCl-Soaked Media After Drying

written instructions had been provided by Kinetico and no reliable communications had been established between the operator and Battelle, it was not clear how the acid and caustic washes were actually performed at the site.

By March 2007, a set of written procedures was received from Kinetico. Key steps of the procedures are summarized as follows:

- Begin the 10% HCl wash with two back-to-back backwashes on both vessels.
- Isolate the vessel to be washed by disabling the vessel with the touch screen. Also close the hand valves for all service lines so that nothing can enter the vessel during the wash.
- Drain water in the vessel to approximately 1 ft above the media bed.
- Dispense 150 gal of 30% HCl to the media bed. Afterwards, close the top of the vessel and airsparge the media for a minimum of 5 min.
- Continue to airsparge the media for 5 min per hour while the media is being soaked in the acidic solution.
- Allow the media to sit in the acidic solution overnight (more than 20 hr of contact, however, may cause damage to the lower distributors).
- Slowly fill the vessel completely with water; perform backwash to rinse out any remaining acid in the vessel.
- Continue the 10% NaOH wash by repeating the acid wash procedure.
- Dispense 100 gal of 50% caustic into the vessel and allow the media to soak for 2 hr.

- Airsparge the media bed every 15 min.
- Rinse out any remaining NaOH in the vessel with backwash.
- Ensure that all valves are in the correct positions before enabling the vessels on the touch screen and bring the system back online.

Because the media continued to show signs of biofouling and required more frequent backwashing, three additional acid washes were performed by the operator in March, July and October 2009. The amounts of HCl used were 25 and 50 gal for the March and July washes, respectively. The amount used for the October wash was unknown. The amounts used for the March and July washes were significantly lower than the amount (i.e., 150 gal of 30% HCl) recommended by Kinetico; this probably was the reason why these washes were not as effective (in terms of restoring the system flowrate and backwash frequency) as the one performed in December 2006.

- **4.4.4 Residual Management.** Residuals produced by the Macrolite<sup>®</sup> arsenic removal system included backwash wastewater and filter to waste water, which contained arsenic-laden solids as discussed in Section 4.5.2. Wastewater from backwash was discharged to the building sump, which was emptied by gravity to a pond as shown in Figure 4-13. According to the backwash flow totalizer, 19,834,500 gal of wastewater was produced during the entire study period.
- **4.4.5 Reliability and Simplicity of Operation.** Inability to consistently remove arsenic to <10 μg/L was the main issue encountered during the performance evaluation study. This was caused primarily by the unintended aeration in the pre-existing aeralater and resulting biofouling of the filter media in the pressure filters. Another unfortunate consequence of the unintended aeration was misinterpretation of the above-the-MCL treatment results, which led the project team to conclude that supplemental iron would be needed to enhance arsenic removal. While addition of FeCl<sub>3</sub> resulted in little improvement to arsenic removal, additional solid loading to the pressure filters required them to be backwashed even more frequently. Further, chlorine gas was used to replace KMnO<sub>4</sub> due to chlorine's ability to better curb biological growth in the pressure filters, but the use of chlorine might not be a good choice due to the presence of ammonia and TOC in source water. The iron addition process was interrupted a number of times due to erratic dosing rates caused by an oversized pump and a corroding/dissolving piece of mixing equipment (i.e., an impeller and mixer). These, in conjunction with the constantly changing PLC settings/operating conditions and lack of timely communications between the operator and Battelle caused the source water (with a complex chemistry) to be inadequately treated and the treatment system to be improperly operated.

The system O&M and operator skill requirements are discussed below in relation to pre- and post-treatment requirements, levels of system automation, operator skill requirements, preventive maintenance activities, and frequency of chemical/media handling and inventory requirements.

4.4.5.1 Pre- and Post-Treatment Requirements. Pretreatment consisted of chemical additions to improve arsenic removal. KMnO<sub>4</sub> after proper dilutions was added using two LMI metering pumps to oxidize As(III) and Fe(II). KMnO<sub>4</sub> was replaced with gas chlorine using the pre-existing addition system from February 2007 through April 2010. Gas chlorine also was used for post-chlorination to provide chlorine residuals to the distribution system. During December 2007 through July 2009, iron addition was performed using one of the KMnO<sub>4</sub> addition systems. The other post-treatment was softening (with 30% bypass). In addition to tracking the depth of the KMnO<sub>4</sub>, chlorine, and iron solution in the day tanks, the operator measured chlorine concentrations to ensure that residuals existed prior to entering the distribution system.

4.4.5.2 System Automation. The Macrolite® pressure filtration system was automatically controlled by the PLC in the central control panel. The control panel contained a modem and a touch screen OIP that facilitated monitoring of system parameters, changing of system setpoints, and checking the alarm status. Service time, standby time, and  $\Delta p$  settings (Table 4-3) automatically determined when the tanks were backwashed. Due to media fouling and solids loading,  $\Delta p$  setting was responsible for all 3,000 backwashes for each filter. The touch screen OIP also enabled the operator to manually initiate the backwash sequence.

Because the PLC settings and system operating conditions such as backwash flowrate were constantly changed by the operator during system operation, it was difficult to troubleshoot system operational and performance issues and to interpret data, both operational and analytical, for performance improvements.

**4.4.5.3 Operator Skill Requirements.** Under normal operating conditions, the daily demand on the operator was about 30 min for visual inspection of the system and recording of operational parameters, such as pressure, volume, flowrate, and chemical usage on field log sheets. Due to operational and performance issues, the operator spent a significant amount of time working with the vendor and/or Battelle to assist in troubleshooting and performing special studies.

In Louisiana, an operator of any public water system must hold current and valid professional certification(s) of required categories (i.e., water production, water distribution, and water treatment) at or above the level required for the total system and individual facility. Required levels (classes) of certification for an operator, based on facility classification, are from Classes 1 to 4, with Class 1 being the lowest (serving <1,000 population) and Class 4 the highest (over 25,000 population). Because the system at Arnaudville, LA serves approximately 1,200 connections, the operator needs to have a Class 2 certification (serving 1,001 to 5,000 population).

After receiving proper training during the system startup, the operator understood the PLC, knew how to use the touch screen OIP, and was able to work with the vendor to troubleshoot problems and perform onsite repairs.

4.4.5.4 Preventative Maintenance Activities. The vendor recommended several routine maintenance activities to prolong the integrity of the treatment system (Kinetico, 2005). Daily preventative maintenance tasks included recording pressures, flowrates, chemical drum levels, and visually checking for leaks, overheating components, proper manual valve positioning and pumps' lubricant levels, and any unusual conditions. The vendor recommended weekly checking for trends in the recorded data that might indicate a decline in system performance, and semi-annually servicing and inspecting ancillary equipment and replacing worn components. Cleaning and replacement of sensors and replacement of o-ring seals and gaskets of valves were performed as needed.

#### 4.5 System Performance

The performance of the Macrolite<sup>®</sup> Arsenic Removal System was evaluated based on analyses of water samples collected from the treatment plant, backwash line, and distribution system.

**4.5.1 Treatment Plant Sampling.** Treatment plant water was sampled on a total of 69 occasions, including three duplicate events and 41 speciation events. From August 10, 2006, through April 30 2007, 37 sampling occasions took place, including three duplicate events and nine speciation events. After April 30, 2007, sampling was suspended to await the implementation of supplement iron addition. Once iron addition began in December 2007, sampling resumed on January 23, 2008, but was on again and off again until March 30, 2009. During this period, 13 speciation sampling events took place. After supplemental iron addition ended in July 2009, sampling resumed in August 2009 and continued until

February 9, 2010. A single sampling event took place on August 5, 2010, after piping to bypass the aeralater had been installed. From August 18, 2009, through February 9, 2010, 19 speciation sampling events took place.

Tables 4-9 summarizes analytical results of all analytes without iron addition (excluding the August 5, 2010, data after aeralater bypassing). Table 4-10 summarizes analytical results of all analytes with iron addition. The results shown in these two tables represent data impacted, to a varying degree, by aeration in the aeralater. Appendix B contains a complete set of analytical results. The results of the water samples collected across the treatment plant are discussed below.

Table 4-9. Analytical Results (Without Iron Addition)(a)

	Sampling		Sample	C	oncentration		Standard
Parameter	Location	Unit	Count	Minimum	Maximum	Average	<b>Deviation</b>
Tarameter	IN	μg/L	55	24.1	43.0	32.7	4.9
	AC	μg/L μg/L	55	25.3	41.8	33.8	4.9
As (total)	TA	μg/L μg/L	29	8.7	27.7	13.8	4.2
As (total)	TB	μg/L μg/L	29	9.5	28.5	14.3	3.9
	TT	μg/L μg/L	27	1.4	19.0	11.7	4.3
	IN	μg/L μg/L	27	11.1	37.7	29.1	4.3
	AC	μg/L μg/L	27	2.2	30.9	13.3	5.2
As (soluble)		μg/L μg/L	1	9.6	9.6	9.6	
As (soluble)	TA TB	μg/L μg/L	1	9.6	9.6	9.8	-
	TT	μg/L μg/L	27	0.3	16.2	10.1	3.3
	IN		27	<0.1		2.7	4.6
	AC	μg/L μg/L	27	3.6	22.7 30.2	19.7	5.2
As	TA	μg/L μg/L		<0.1	<0.1	<0.1	
(particulate)	TB	μg/L μg/L	1	1.1	1.1	1.1	-
			27		9.8	1.1	2.7
	TT IN	μg/L		<0.1	35.2		
		μg/L	27 27	0.4		24.4	7.2
Ag(III)	AC TA	μg/L	1	<0.1	27.2 1.5	1.5	5.4
As(III)	TB	μg/L	1	1.3	1.3	1.3	_
	TT	μg/L μg/L	27	0.1	5.6	1.4	1.2
	IN	μg/L μg/L	27	<0.1	19.9	4.7	
		μg/L μg/L		1.3			5.1
A a(M)	AC	μg/L μg/L	27	8.0	19.0 8.0	10.8	3.6
As(V)	TA TB	μg/L μg/L	1	8.4	8.4	8.0	
	TT	μg/L μg/L	27	<0.1		9.0	3.1
	IN	μg/L μg/L	55	1,477	14.1 2,939	2,059	279
	AC	μg/L μg/L	55	1,385	2,701	1,995	285
Fe (total)	TA	μg/L μg/L	29	<25	92.7	17.6	17.2
re (total)	TB		29	<25	149	21.6	32.2
	TT	μg/L μg/L	27	<25		166	264
	IN	μg/L μg/L	27	<25	1,037 3,276		683
		μg/L μg/L	27			1,906	373
Fe (soluble)	AC TA	μg/L μg/L		<25	1,956	97	0.0
re (soluble)			1	<25	<25 <25	<25	
	TB	μg/L	1	<25		<25	0.0
	TT	μg/L	27	<25	<25	<25	0.0

Table 4-9. Analytical Results (Without Iron Addition)<sup>(a)</sup> (Continued)

	Sampling		Sample	Concentration			Standard
Parameter	Location	Unit	Count	Minimum	Maximum	Average	<b>Deviation</b>
1 1111111111111111111111111111111111111	IN	μg/L	55	96.2	196	133	20.4
	AC	μg/L	55	90.2	932	334	262
Mn (total)	TA	μg/L μg/L	29	21.3	605	240	144
Will (total)	TB						263
	-	μg/L	29	101	1,443	316	
	TT	μg/L	27	99.9	384	151	78.1
	IN	μg/L	27	28.9	180	130	28.2
	AC	μg/L	27	21.4	478	166	126
Mn (soluble)	TA	μg/L	1	135	135	135	-
	TB	μg/L	1	136	136	136	-
	TT	μg/L	27	20.2	394	151	85.8
	IN	mg/L	26	193	440	278	55.1
Total	AC	mg/L	26	198	438	271	54.1
Hardness	TA	mg/L	1	215	215	215	-
(as CaCO <sub>3</sub> )	TB	mg/L	1	222	222	222	-
	TT	mg/L	26	187	439	267	54.5
	IN	mg/L	26	104	316	182	47.1
Ca Hardness	AC	mg/L	26	107	316	178	46.6
(as CaCO <sub>3</sub> )	TA	mg/L	1	128	128	128	-
(45 242 23)	TB	mg/L	1	133	133	133	-
	TT	mg/L	26	100	316	175	46.6
	IN	mg/L	26	77.1	124.4	95.5	11.4
Mg Hardness	AC	mg/L	26	75.8	122.4	92.4	11.2
(as CaCO <sub>3</sub> )	TA	mg/L	1	86.2	86.2	86.2	-
3)	TB	mg/L	1	89.0	89.0	89.0	-
	TT	mg/L	26	72.3	123.8	92.0	10.4
	IN	mg/L	27	0.1	0.3	0.2	0.05
F1 '1	AC	mg/L	27	<0.1	0.3	0.2	0.05
Fluoride	TA	mg/L	1	0.2	0.2	0.2	-
	TB	mg/L	1	0.2	0.2	0.2	-
	TT	mg/L	27	<0.1	0.8	0.2	0.2
	IN	mg/L	27	< 0.05	<0.05	< 0.05	0.0
Nitrate	AC	mg/L	27	< 0.05	0.1	< 0.05	0.0
(as N)	TA	mg/L	1	< 0.05	<0.05	< 0.05	-
	TB	mg/L	1 27	<0.05	<0.05	< 0.05	- 0.2
	TT	mg/L	27	< 0.05	0.6	0.1	0.2
	IN	mg/L	27	1.5	2.2	1.9	0.1
Ammonia	AC	mg/L	27	0.9	2.0	1.7	0.2
(as N)	TA TB	mg/L	1 1	1.9	1.9	1.9	-
	<del> </del>	mg/L	27	1.9	1.9	1.9	0.5
	TT	mg/L	27	0.2	2.0	1.4	0.5
	IN	mg/L	27	<0.1	0.5	0.2	0.2
Sulfate	AC	mg/L	27	<0.1	0.5	0.2	0.2
Sulfate	TA TB	mg/L	1 1	<0.1	<0.1	<0.1	-
	<del> </del>	mg/L	27	<0.1	<0.1	<0.1	0.2
	TT	mg/L	27	<0.1	0.5	0.2	0.2
	IN	mg/L	55 55	38.4	49.3	42.5	2.6
Silica	AC	mg/L	55	40.3	50.0	43.3	2.5
(as SiO <sub>2</sub> )	TA	mg/L	29	39.6	50.1	41.9	1.9
-	TB	mg/L	29	38.0	49.6	41.8	2.0
	TT	mg/L	27	39.8	49.6	44.5	3.1

Table 4-9. Analytical Results (Without Iron Addition)<sup>(a)</sup> (Continued)

	Sampling		Sample	C	Concentration		Standard
Parameter	Location	Unit	Count	Minimum	Maximum	Average	Deviation
	IN	μg/L	38	474	873	648	94.8
	AC	μg/L	38	585	819	714	51.6
Phosphorus	TA	μg/L	28	149	278	199	27.7
(as P)	TB	μg/L	28	112	298	199	34.2
	TT	μg/L	10	177	323	225	43.5
	IN	mg/L	24	<1.0	1.9	1.3	0.4
	AC	mg/L	24	1.0	2.4	1.4	0.3
TOC	TA	mg/L	2	1.2	1.4	1.3	0.1
	TB	mg/L	2	1.2	1.4	1.3	0.1
	TT	mg/L	23	<1.0	1.7	1.2	0.4
	IN	mg/L	55	290	368	333	14.1
A 11 11 . 14-	AC	mg/L	55	294	368	337	17.1
Alkalinity	TA	mg/L	29	312	359	336	11.2
(as CaCO <sub>3</sub> )	TB	mg/L	29	317	371	337	11.8
	TT	mg/L	27	302	354	326	15.6
	IN	NTU	55	9.2	38.0	25.1	5.6
	AC	NTU	55	1.7	16.0	4.2	2.7
Turbidity	TA	NTU	29	0.1	7.2	0.8	1.3
	TB	NTU	29	0.1	4.4	0.7	0.8
	TT	NTU	27	0.1	2.1	0.7	0.5
	IN	S.U.	27	6.0	7.0	6.8	0.2
	AC	S.U.	27	7.0	7.4	7.3	0.1
pН	TA	S.U.	19	7.2	7.5	7.3	0.1
	TB	S.U.	20	7.2	7.5	7.3	0.1
	TT	S.U.	7	7.3	7.5	7.4	0.1
	IN	°C	27	14.6	25.0	20.9	2.5
	AC	°C	26	16.6	25.0	21.3	2.3
Temperature	TA	°C	20	17.3	24.9	21.3	2.0
	TB	°C	20	17.5	25.0	21.3	2.0
	TT	°C	7	16.8	25.0	21.0	3.2
	IN	mg/L	26	0.9	4.7	2.8	0.8
	AC	mg/L	26	3.1	7.2	5.5	0.8
DO	TA	mg/L	19	2.1	6.2	3.8	1.2
	TB	mg/L	19	1.6	6.1	3.7	1.4
	TT	mg/L	7	3.1	5.6	4.1	1.0
	IN	mV	26	-6.7	428	266	188
	AC	mV	27	140	479	335	93.0
ORP	TA	mV	19	207	479	347	87.5
	TB	mV	19	213	463	358	78.2
	TT	mV	7	247	415	353	70.3

<sup>(</sup>a) Excluding the event on August 5, 2010 (after piping to bypass aeralater had been installed).

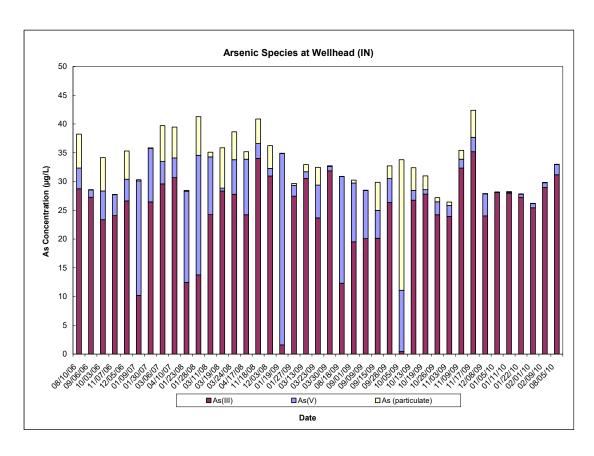
4.5.1.1 Arsenic. Figure 4-30 presents the results of all 41 speciation events, including nine, 13, and 19 before, during, and after iron addition, respectively. As shown on the first bar chart (for samples collected at the wellhead [IN]) and Tables 4-9 and 4-10, total arsenic concentrations in raw water ranged from 24.1 to 43.0  $\mu$ g/L and averaged 33.1  $\mu$ g/L with 91% (on average) existing in the soluble form. Of the soluble fraction, As(III) (scarlet on bar charts) was the predominant species with concentrations ranging from 0.4 to 35.2  $\mu$ g/L and averaging 24.2  $\mu$ g/L. Low levels of As(V) (blue on bar charts) also were present, ranging from <0.1 to 33.3  $\mu$ g/L and averaging 5.9  $\mu$ g/L. The range of total arsenic

Table 4-10. Analytical Results (with Iron Addition)

	Sampling		Sample	C	Standard		
Parameter	Location	Unit	Count	Minimum	Maximum	Average	Deviation
	IN	μg/L	13	28.5	41.3	34.8	3.9
As (total)	AC	μg/L	13	18.7	41.8	34.1	5.5
	TT	μg/L	13	5.6	22.8	11.0	4.4
	IN	μg/L	13	28.3	36.6	32.3	2.7
As (soluble)	AC	μg/L	13	2.5	14.9	9.5	3.6
	TT	μg/L	13	4.7	12.6	8.1	2.2
	IN	μg/L	13	0.1	7.0	2.6	2.5
As	AC	μg/L	13	7.7	34.4	24.7	7.0
(particulate)	TT	μg/L	13	0.2	10.2	2.9	3.0
	IN	μg/L	13	1.6	34.0	23.9	9.3
As(III)	AC	μg/L	13	0.3	1.3	0.8	0.3
	TT	μg/L	13	0.2	1.2	0.8	0.3
	IN	μg/L	13	0.5	33.3	8.4	9.8
As(V)	AC	μg/L	13	1.7	14.0	8.6	3.6
	TT	μg/L	13	3.9	11.8	7.3	2.2
	IN	μg/L	13	1,768	8,045	2,629	1,641
Fe (total)	AC	μg/L	13	701	9,399	3,173	2,216
	TT	μg/L	13	<25	1,763	360	587
	IN	μg/L	13	<25	6,314	2,188	1,473
Fe (soluble)	AC	μg/L	13	<25	32.2	16.5	7.7
	TT	μg/L	13	<25	<25	<25	0.0
	IN	μg/L	13	107	195	130	23.0
Mn (total)	AC	μg/L	13	106	170	129	18.6
	TT	μg/L	13	76.3	156	116	22.6
Mn	IN	μg/L	13	109	199	133	23.2
(soluble)	AC	μg/L	13	90.8	155	117	18.6
(soluble)	TT	μg/L	13	76.4	157	117	20.2
	IN	μg/L	3	726	832	787	55.1
P (as P)	AC	μg/L	3	779	1,718	1,106	530
	TT	μg/L	3	108	172	143	32.5

concentrations measured was slightly higher than that of historic data, i.e., 17.0 to 37.0  $\mu g/L$ , as shown in Table 4-1.

As shown on the second bar chart (for samples collected after the contact tank [AC]), KMnO<sub>4</sub> was effective in converting soluble As(III) to either soluble As(V) or particulate arsenic, with soluble As(V) concentrations ranging from 6.9 to 16.2  $\mu$ g/L and averaging 10.8  $\mu$ g/L and particulate arsenic concentrations ranging from 13.0 to 28.1  $\mu$ g/L and averaging 20.4  $\mu$ g/L. The high soluble As(V) concentrations measured were contrary to what would be anticipated because of a high soluble iron to soluble arsenic ratio (i.e., 1,998  $\mu$ g/L:30.1  $\mu$ g/L = 66.4 [see Tables 4-9 and 4-10]) in source water. In fact, soluble As(V) concentrations at the AC location were found to be higher or close to the 10- $\mu$ g/L MCL during 16 of the 28 speciation events (whether KMnO<sub>4</sub> or chlorine was used as an oxidant). The rule of thumb was that soluble As(V) formed from soluble As(III) oxidation would be attached to iron solids via adsorption and/or co-precipitation as long as the soluble iron concentration is at least 20 times the soluble arsenic concentration (Sorg, 2002). The presence of high amounts of soluble As(V) in the filter influent were not desirable because the Macrolite<sup>®</sup> media presumably would remove only particulate arsenic, leaving soluble As(V) and residual soluble As(III) in the filter effluent. This was what prompted



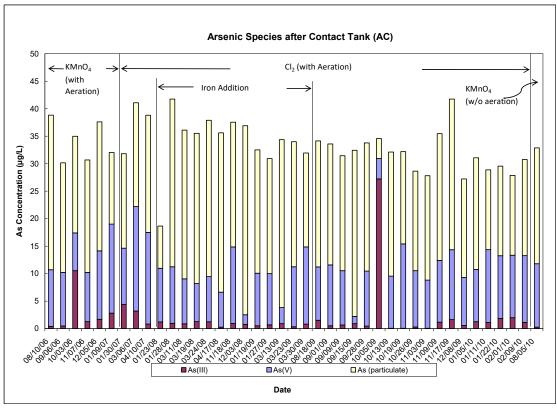


Figure 4-30. Arsenic Speciation Results at IN, AC, and TT Sampling Locations

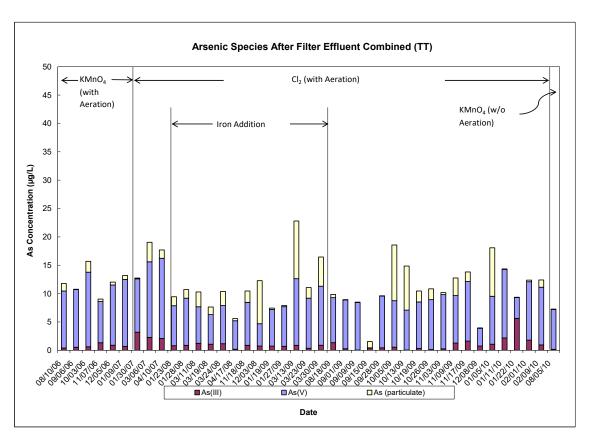


Figure 4-30. Arsenic Speciation at IN, AC, and TT Sampling Locations (Continued)

the decision, made almost immediately after the treatment plant water sampling had begun, to add supplemental iron to the inlet water to enhance arsenic removal.

On October 3, 2006, as much as  $10.5~\mu g/L$  of soluble As(III) was measured after the contact tank, presumably caused by an unusually low KMnO<sub>4</sub> dosing rate as reflected by the low manganese concentration, i.e.,  $361~\mu g/L$  [as Mn] or 1.0~m g/L [as KMnO<sub>4</sub>] measured in the same sample. The target KMnO<sub>4</sub> dosage was 2.6~m g/L (as KMnO<sub>4</sub>).

Due to concerns over biofouling in the media beds, gas chlorine was used to replace KMnO<sub>4</sub> by late January 2007. Immediately after the oxidant replacement, soluble As(III) concentrations at the AC location increased to 4.4 and 3.2  $\mu$ g/L on January 30 and March 6, 2007. Incomplete soluble As(III) oxidation might have been caused by the presence of ammonia (1.9 mg/L [as N]), which formed chloramines with chlorine. Chloramines are known to react less effectively with As(III) (Frank and Clifford, 1986; Ghurye and Clifford, 2001). Elevated As(III) concentrations did not reoccur after the sampling event on March 6, 2007.

On October 5, 2009, as much as 27.0  $\mu$ g/L of soluble As(III) was measured at the AC location. This uncharacteristically high soluble As(III) concentration was thought to have been caused by the lack of chlorine addition, although the operator did not report any irregularity during this study period. Because the soluble iron concentration in the same sample also was unusually high (1,956  $\mu$ g/L), malfunctioning of the gas chlorine addition system most likely was the case. Aeration in the aeralater did not appear to have oxidized much of the soluble iron either when comparing its concentration with that of total iron.

No DO or ORP data were available to support or refute this. Onsite measurements for pH, temperature, DO, and ORP were discontinued by the operator on April 30, 2007.

A number of factors potentially could affect soluble As(V) adsorption onto and co-precipitation with iron solids. Competing anions, such as phosphorus and silica, could use up some adsorption sites. Phosphorus concentrations in source water ranged from 474 to 873 μg/L (as P) and averaged 658 μg/L (as P) (see Tables 4-9 and 4-10). Phosphorus concentrations at the AC location ranged from 585 to 819 μg/L (as P) and averaged 714 μg/L (as P) (see Table 4-9). Although phosphorus concentrations at the AC location were similar to those in source water, its concentrations were significantly reduced after Macrolite pressure filters (to 199 and 225 μg/L [as P], on average, at the TA/TB and TT locations, respectively). Silica concentrations in source water ranged from 38.4 to 49.3 mg/L (as SiO<sub>2</sub>) and averaged 42.5 mg/L (as SiO<sub>2</sub>). Its concentrations at the AC, TA, TB, and TT locations remained relatively constant at 43.3, 41.9, 41.8, and 44.5 mg/L (as SiO<sub>2</sub>). Based on the concentrations at the TA and TB locations, some silica might have been removed along with iron solids, similar to what had occurred for phosphorus.

The other factor that might have impacted soluble As(V) removal was aeration in the aeralater. Although KMnO<sub>4</sub> or chlorine was added to either the wellheads or the 6-in standpipe prior to the aeralater, some soluble iron might have reached the aeralater and precipitated upon aeration. Based on field measurements, DO concentrations at the wellhead were 2.8 mg/L (note that results of two special studies conducted onsite showed <0.2 mg/L of DO at the wellheads); DO concentrations after the aeralater increased significantly to 5.5 mg/L. According to the results of the same special studies, soluble As(V) concentrations were reduced to below 5.9 mg/L after KMnO<sub>4</sub> oxidation (with most converted to particulate arsenic) if DO levels were kept at the wellhead levels (see Section 4.5.2.3).

Without supplemental iron addition, total arsenic concentrations following the pressure filters at the TA, TB, and TT locations ranged from 1.4 to 28.5  $\mu$ g/L and averaged 13.3  $\mu$ g/L (Table 4-9 and Figure 4-31). Arsenic existed primarily in the soluble form with concentrations ranging from 0.3 to 16.2  $\mu$ g/L and averaging 10.1  $\mu$ g/L. As expected, soluble As(V) was the predominant species, with concentrations ranging from <0.1 to 14.1  $\mu$ g/L and averaging 9.0  $\mu$ g/L (see the third bar chart in Figure 4-30). It is obvious that soluble As(V) must be converted to particulate arsenic before it can be removed by the pressure filters. The amount of particulate arsenic was low, ranging from <0.1 to 9.8  $\mu$ g/L and averaging 1.7  $\mu$ g/L (light yellow on the bar chart). Elevated particulate arsenic concentrations usually were associated with elevated particulate iron concentrations (see Appendix B for particulate arsenic and particulate iron data at the TT location: 9.8 and 790  $\mu$ g/L, respectively, on October 5, 2009; 7.8 and 732  $\mu$ g/L, respectively, on October 13, 2009; and 8.5 and 1,037  $\mu$ g/L, respectively, on January 5, 2010) and thus iron leakage through the pressure filters.

The effect of iron addition was minimal, slightly decreasing the average soluble arsenic concentration from 13.3 (without iron addition) to 9.5  $\mu$ g/L (with iron addition) and average soluble As(V) concentration from 10.8 (without iron addition) to 8.6  $\mu$ g/L (with iron addition) at the AC location (Tables 4-9 and 4-10 and the second bar chart in Figure 4-30). After the Macrolite® pressure filters, total arsenic concentrations were reduced to 11.0  $\mu$ g/L (on average), with 7.3, 0.8, and 2.9  $\mu$ g/L existing as soluble As(V), soluble As(III), and particulate arsenic. Although more soluble arsenic was converted to particulate arsenic due to iron addition, extra solids loading to the pressure filters caused more particulate arsenic to penetrate through the filters. As a result, little or no benefit was realized from the use of supplemental iron.

4.5.1.2 Iron. Figure 4-32 presents three bar charts showing soluble and particulate concentrations measured at the IN, AC, and TT locations. Total iron concentrations in source water ranged from 1,477 to 8,045  $\mu$ g/L and averaged 2,168  $\mu$ g/L, existing almost entirely in the soluble form. The amounts of

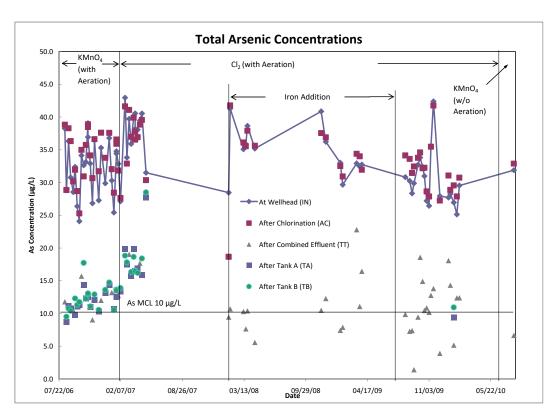


Figure 4-31. Total Arsenic Concentrations at IN, AC, TA, TB, and TT Sampling Locations

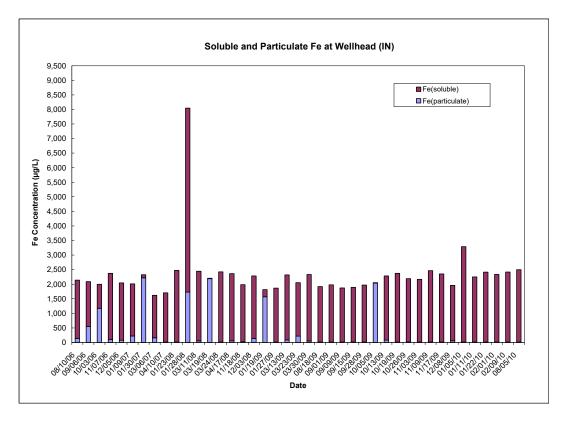
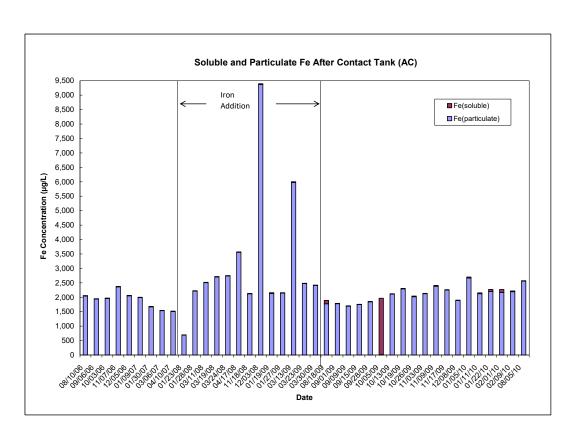


Figure 4-32. Soluble and Particulate Iron Across Treatment Train



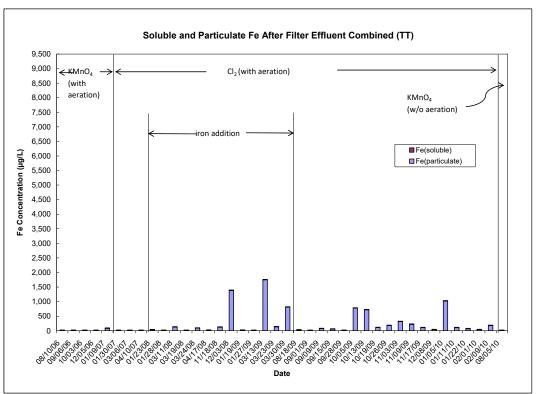


Figure 4-32. Soluble and Particulate Iron Across Treatment Train (Continued)

soluble iron in source water were at least 66 times (on average) the amounts of soluble arsenic. This soluble iron to soluble arsenic ratio was much higher than the 20:1 rule-of-thumb value needed for effective arsenic removal via adsorption/co-precipitation with iron solids. This is why it became suspicious that some soluble iron might, in fact, be precipitated via aeration, rendering it less effective in turning soluble As(V) into arsenic-laden solids. An unusually high iron concentration of 8,045  $\mu$ g/L (with 6,314  $\mu$ g/L existing in the soluble form) was measured on January 28, 2008 (see the first bar chart in Figure 4-32). It was not clear what caused this to occur. Out of the 41 speciation events, the ones on October 3, 2006, January 30, 2007, March 11, 2008, January 19, 2009, and October 5, 2009, had particulate iron as the predominant species. This most likely was caused by aeration during sampling.

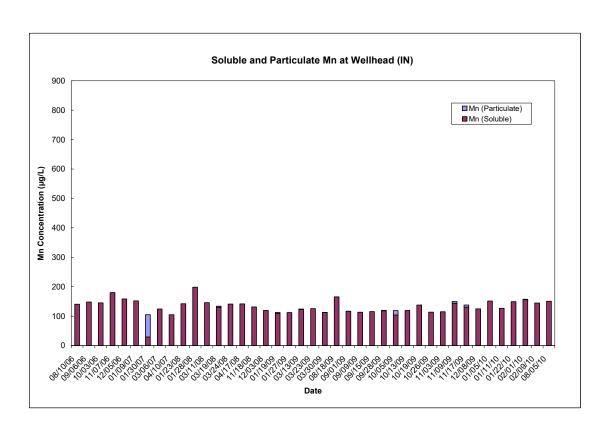
As expected, soluble iron was precipitated to become iron solids after oxidant addition/aeration in the aeralater (see the second bar chart in Figure 4-32). On October 5, 2009, iron at the AC location existed only as soluble iron. As discussed earlier, this most likely was caused by malfunctioning of the chlorine addition system.

With iron addition, total iron concentrations varied from 701 to 9,399  $\mu$ g/L and averaged 3,173  $\mu$ g/L, compared to 1,995  $\mu$ g/L without iron addition. Increases in iron concentration occurred during three sampling events on April 17, 2008, December 3, 2008, and March 13, 2009. As discussed in Section 4.4.2, iron dosages were not well controlled because of the use of an over-sized pump and a corroding/dissolving impeller/mixer. Stratification of iron crystals in the chemical day tank very much could have been a source of errors contributing to the erratic results.

Iron leakage could be seen in the filter effluent as shown in the third bar chart in Figure 4-32. With iron addition, iron concentrations as high as 1,763 µg/L were measured (on March 13, 2009) in the filter effluent. Because of continuing aeration and iron addition, the Macrolite® filters became increasingly fouled and iron leakage became even more significant and frequent during the most of year 2009. This was the reason for the flow dropping even with three consecutive acid washes (although the washes were done with much less amounts of HCl than recommended by the vendor) in March, July and October 2009. Flowrates were "restored" only after rubber grommets in the flow restrictors were removed in October 2009. Iron addition discontinued in July 2009.

4.5.1.3 Manganese. Figure 4-33 presents three bar charts showing soluble and particulate manganese concentrations measured at the IN, AC, and TT locations. Total manganese concentrations in source water ranged from 96.2 to 196 μg/L and averaged 132 μg/L, existing almost entirely in the soluble form (see Tables 4-9 and 4-10). Due to KMnO<sub>4</sub> addition, manganese concentrations increased to as high as 787 μg/L at the AC location during the first six speciation events (and the seventh event apparently with the use of both KMnO<sub>4</sub> and gas chlorine). KMnO<sub>4</sub> reacted with reducing species in source water and formed a significant amount of manganese solids, presumably MnO<sub>2</sub>, as shown by the blue bars in the second bar chart. After KMnO<sub>4</sub> was replaced with gas chlorine, manganese concentrations remained relatively unchanged. Chlorine was not effective in oxidizing soluble manganese, as shown by the mostly scarlet bars in the bar chart. Studies have found that incomplete oxidation of soluble Mn(II) occurs using free chlorine at pH values less than 8.5 (Knocke et al., 1987 and 1990; Condit and Chen, 2006; McCall et al., 2007).

Particulate manganese was removed by the pressure filters (see the third bar chart), leaving mostly soluble manganese in the filter effluent. Four of the first six speciation events showed elevated soluble manganese, probably caused by overdosing of KMnO<sub>4</sub> or formation of colloidal manganese particles due to the presence of TOC in source water.



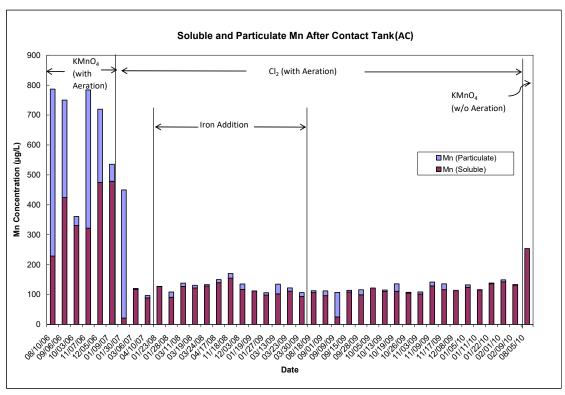


Figure 4-33. Soluble and Particulate Manganese Concentrations Across Treatment Train

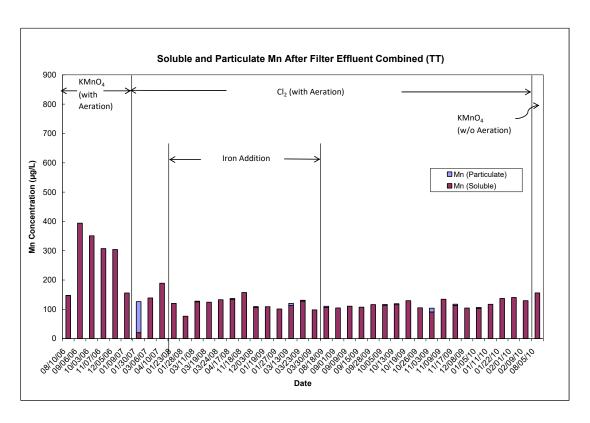


Figure 4-33. Soluble and Particulate Manganese Concentrations Across Treatment Train (Continued)

4.5.1.4 pH, DO, and ORP. pH, temperature, DO, and ORP were measured after system startup through April 17, 2007. Based on the data collected, pH values of source water ranged from 6.0 to 7.0 and averaged 6.8 (Table 4-9). This pH range was somewhat lower than that measured historically (see Table 4-1) and was ideal for arsenic adsorption onto iron solids. DO levels in source water ranged from 0.9 to 4.7 mg/L and averaged 2.8 mg/L. This average value was much higher than the DO levels measured during the first several sampling events, i.e., 1.5, 0.9, 2.2, and 1.7 mg/L on August 10, August 15, August 22, and August 29, 2006, respectively. Higher DO levels measured most likely were caused by aeration during sampling and measurements. Similar to DO, ORP readings taken during the first several events were much lower than the average value (266 mV) measured during the entire sampling period. For example, -2.7, -6.7, 6.1, 5.4, 3.1, and 5.7 mV were measured during the first six of seven sampling events. Aeration again was thought to be the main contributing factor for the high readings. Great caution must be taken during DO and ORP measurements, although the project team did experience frequent malfunctioning of DO probes and excessive drifting when taking ORP measurements at this and a large number of other arsenic demonstration sites.

After oxidant addition and the aeralater, the average pH value increased to 7.3 but remained constant across the pressure filters. DO levels increased significantly to an average of 5.5 mg/L, indicating aeration. After the blower in the aeralater were turned off, DO levels remained elevated at 2.4 to 3.4 mg/L, indicating continuing aeration (but at a lesser extent). As noted earlier, aeration might have adversely affected soluble As(V) removal by iron solids. No routine DO measurement was made after the aluminum trays had been removed and the standpipe in the aeralater was cut in July 2009. Therefore, the effect of this action was not clear. However, the DO measurements performed during the January 2010 special study indicated an elevated DO level of 2.4 mg/L at the AC location. After the aeralater was

bypassed, the DO level was reduced to 0.5 mg/L. Results of this special study are discussed in detail in Section 4.5.2.2.

4.5.1.5 Ammonia and Nitrate. As shown in Table 4-9, ammonia concentrations ranged from 1.5 to 2.2 mg/L (as N) and averaged 1.9 mg/L (as N). Ammonia concentrations were reduced to 1.7 and 1.4 mg/L (as N) at the AC and TT locations, respectively. Nitrification and/or chlorination were primarily responsible for the concentration reduction. Before gas chlorine was used to replace KMnO<sub>4</sub> by the end of January 2007, nitrification was the only process consuming ammonia. Ammonia concentrations were reduced from 2.0 mg/L (as N), on average, at the wellhead to 1.8 mg/L (as N), on average, after the aeralater. After the pressure filters, its concentrations were further reduced to 0.9 mg/L (as N), on average.

With the blower on, nitrification was active seven weeks into system operation, as evidenced by a lower ammonia concentration, i.e., 1.3 mg/L (as N), in the filter effluent on August 10, 2006 (see Figure 4-34). Ammonia concentrations after the filters were further reduced to 1.1, 0.6. 0.5, and 0.8 mg/L (as N) by September 6, October 3, November 7, and December 5, 2006, respectively. This was when the backwash frequency increased to as many as eight times per day and an acid and a caustic wash were recommended by the vendor. At this point, nitrate concentrations had increased to 0.6 mg/L (as N). The increase in nitrate concentration, however, was less than the stoichiometric amount.

After the acid and caustic washes, biological activities apparently were under control, as reflected by the essentially "constant" level of ammonia (i.e., 1.5, 1.7, and 1.7 mg/L [as N]) and less than the MDL of nitrate (0.05 mg/L [as N]) across the treatment train. To curb biofouling, gas chlorine was used to replace KMnO<sub>4</sub> by the end of January 2007, and the blower was turned off by March 2007. From late January through April 30, 2007, when the routine sampling was temporarily discontinued, ammonia levels were reduced, on average, from 1.9 mg/L (as N) at the wellhead to 1.7 mg/L (as N) after the aeralater, and then to 1.4 mg/L (as N) after the filters. Assuming that the 0.2 mg/L (as N) of concentration reduction (from 1.9 down to 1.7 mg/L [as N]) was caused by chlorination, the 0.3-mg/L (as N) reduction across the filters could have been caused, again, by nitrification (note that 0.1 mg/L of nitrate [as N] was measured on April 10, 2007). The extent of nitrification, if any, definitely was much less significant than before.

After the aluminum tray was removed and standpipe was cut in July 2009, ammonia concentration reduction was observed only across the aeralater (i.e., from 2.0 mg/L [as N] at the wellhead to 1.7 mg/L [as N] after the aeralater), presumably caused by chlorination. Ammonia concentrations remained unchanged at 1.7 mg/L (as N) after the filters. Therefore, little or no nitrification would occur at this point. Nitrate concentrations measured in this study period were either less than the MDL or at 0.1 mg/L (as N).

- 4.5.1.6 Other Water Quality Parameters. Hardness, fluoride, sulfate, silica, TOC, and alkalinity levels remained constant across the treatment train and were not affected by the treatment process (Table 4-9). Phosphorus levels after the aeralater, which were slightly higher than the average raw water concentration of 648 μg/L (possibly due to trace quantities in the pretreatment chemicals), decreased to an average of 225 μg/L after the pressure filters (see discussion in Section 4.5.1). Turbidity also decreased significantly with treatment (i.e., from 25.1 NTU in source water to 0.7 NTU after the TT location).
- **4.5.2 Special Studies.** Several special studies were conducted to attempt to improve system performance during the performance evaluation study. Results of these studies are discussed in detail below.

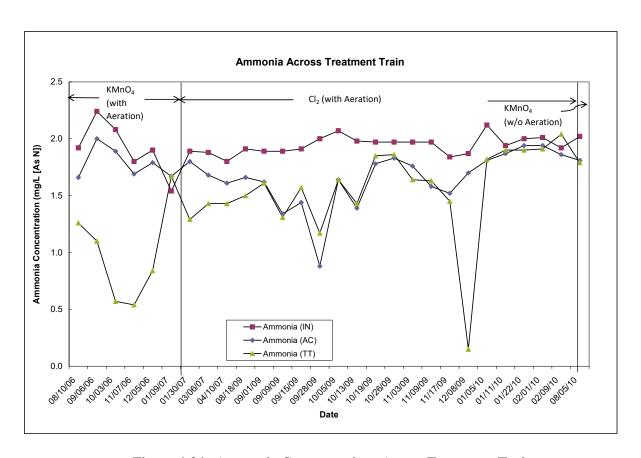


Figure 4-34. Ammonia Concentrations Across Treatment Train

4.5.2.1 Filter Run Length Studies. Three filter run length studies were performed. The first was conducted on November 19, 2007, before the implementation of supplemental iron addition. The test run was short (3.2 hr), with 11.4 to 12.9  $\mu$ g/L of soluble arsenic but less than the MDL of particulate iron in the filter effluent.

After iron addition had begun, a second filter run length study was conducted on May 29, 2008. The results showed no As(III) oxidation nor arsenic-laden iron solids removal based on total and soluble arsenic and iron data, apparently caused by a problem with the chlorine addition system.

A repeat run length study was conducted on October 20, 2008, but the results indicated that iron dosage was too low due to an on-going problem with the mixing equipment, which continued to corrode and dissolve. No additional run length studies were attempted after the three rather unsuccessful tests.

4.5.2.2 Aerelater Bypass Test. Aeration in the aeralater might have caused ineffective soluble As(V) removal by iron solids using either  $KMnO_4$  or chlorine. For the IR process to be effective, iron must be precipitated in the presence of soluble As(V), as this induces co-precipitation and/or adsorption of soluble As(V) and forms arsenic-laden iron particles prior to filtration. Although  $KMnO_4$  or chlorine was added just before water entered the aeralater, soluble iron and soluble As(III) could still exist as water exited the standpipe. This might result in precipitation of soluble iron and contact of iron solids with soluble As(V) and soluble As(III), thus hindering the adsorption/co-precipitation process.

To verify the adverse effect of aeration, the aeralater was bypassed by diverting well water directly to the pressure filters after chlorination. Samples were taken at the AC sampling location for DO and arsenic speciation measurements. It was postulated that bypassing the aeralater would eliminate aeration, thus decreasing soluble As(V) concentrations and increasing particulate arsenic concentrations prior to the pressure filters. However, the presence of ammonia could skew the results due to formation of chloramines, which were less effective in oxidizing soluble As(III) and soluble Fe(II).

Table 4-11 compares results of the samples taken before and after aerelater bypass. As measured during the initial site visit on November 3, 2004 and the first several sampling events after system startup, source water was highly reducing, with an ORP reading of -42 mV and a DO concentration of 0.1 to 0.2 mg/L (note the method of source water sample collection in Section 3.4.2.1). Before aerator bypass, water taken at the AC location contained 2.4 mg/L of DO, indicating aeration despite removal of the aluminum trays and shortening of the standpipe. The ORP reading increased, as expected, to as high as 483.0 mV due to chlorination. About 0.9 mg/L of total chlorine (as Cl<sub>2</sub>) was measured, presumably existing as chloramines. This level of total chlorine was acceptable for protection of the synthetic zeolite in the downstream softening unit.

Table 4-11. Results of Samples Taken Before and After Aeralater Bypass

			S	ampling	Location	ns	
		IN	V	A	C	T	Γ
Analytes	Unit	Before	After	Before	After	Before	After
рН	S.U.	6.9	NA	7.1	6.9	7.2	NA
Temperature	°C	20.9	NA	20.8	20.3	20.8	NA
DO	mg/L	0.1	0.2	2.4	0.5	3.8	NA
ORP	mV	-42	-42.4	483	327	406	NA
Total Chlorine (as Cl <sub>2</sub> )	mg/L	NA	NA	0.9	1.6	0.8	NA
NH <sub>3</sub> (as N)	mg/L	NA	NA	1.1	0.9	NA	NA
As (total)	μg/L	NA	NA	29.5	29.8	NA	NA
As (soluble)	μg/L	NA	NA	11.8	12.5	NA	NA
As (particulate)	μg/L	NA	NA	17.7	17.3	NA	NA
As(III)	μg/L	NA	NA	0.9	0.5	NA	NA
As(V)	μg/L	NA	NA	10.9	12.0	NA	NA
Fe (total)	μg/L	NA	NA	1,824	1,943	NA	NA
Fe (soluble)	μg/L	NA	NA	33.2	45.6	NA	NA
Mn (total)	μg/L	NA	NA	109	113	NA	NA
Mn (soluble)	μg/L	NA	NA	111	103	NA	NA

DO = dissolved oxygen; NA = not available; ORP = oxidation-reduction potential

Metals analyses for samples taken at the AC location before aerator bypass showed 29.5  $\mu$ g/L of total arsenic with about one third (11.8  $\mu$ g/L) present as soluble arsenic. Of the soluble arsenic fraction, most (10.9  $\mu$ g/L) was present as As(V), similar to what had been observed during the entire study period. This soluble fraction was not removed by the filters and was in the filter effluent. As expected, manganese existed entirely in the soluble form.

After aeralater bypass, DO in water sampled from the AC location remained low (0.5 mg/L). Contrary to what would be anticipated, the low DO level did not result in a lower level of soluble arsenic or As(V) (which were measured at 12.5 and 12.0  $\mu$ g/L, respectively). It was not clear if the formation of chloramines had played a role on these unexpected results. Additional examination on jar test results would be needed to verify these results.

4.5.2.3 Jar Tests. Tables 4-12 and 4-13 present results of optimal oxidant dose and arsenic and iron removal tests, respectively. Figure 4-35 shows arsenic speciation results obtained during the arsenic and iron removal tests. The use of 2.2 to 7.1 mg/L NaOCl (as Cl<sub>2</sub>) left 0.8 to 3.9 mg/L (as Cl<sub>2</sub>) of residual in glass jars after 20 min of contact time, indicating a demand of 1.4 to 3.2 mg/L (as Cl<sub>2</sub>). The increasing chlorine demand was contrary to the assumption that a finite and consistent amount of reducing species existed in raw water. At higher chlorine doses, more chlorine may react with TOC in water, thus resulting in higher chlorine demands. However, reactions between chlorine and TOC may or may not result in lower TOC levels in the treated water.

To protect the downstream synthetic zeolite in the softening unit, the 2.2-mg/L (as  $Cl_2$ ) dose was selected for the follow-on arsenic and iron removal jar test (because it resulted in a residual level below 1.0 mg/L [as  $Cl_2$ ] as shown in Table 4-12). However, after 20 min of contact time, only 0.1 mg/L (as  $Cl_2$ ) of residual was measured in the glass jar (see Table 4-13). This, in conjunction with the high levels of soluble arsenic (22.3  $\mu$ g/L), soluble As(III) (4.8  $\mu$ g/L), and soluble iron (730  $\mu$ g/L), suggest that the 2.2-mg/L (as  $Cl_2$ ) dose was not enough to react with all reducing species in the water tested. As shown in Table 4-13, more than 2.1 mg/L of total iron (existing entirely as soluble iron) was present in water collected for the NaOCl jar test and more than 2.6 mg/L of total iron present in water for the KMnO<sub>4</sub> jar tests (raw water quality not measured). Water quality apparently had changed during the 2-day study period, thus causing insufficient addition of chlorine during the jar test.

Table 4-12. Jar Test Results for Optimal Oxidant Doses

Oxidant	Dose (mg/L)	Contact Time (min)	Residual Oxidant (mg/L)	Oxidant Demand (mg/L)
NaOCl	0.0	20	0	NA
	2.2	20	0.8	1.4
	4.2	20	2.3	1.9
	7.1	20	3.9	3.2
KMnO <sub>4</sub>	0.00	20	0.00	NA
	1.9	20	0.9	1.0
	4.2	20	2.8	1.4
	6.6	20	5.0	1.6

NA = not applicable

As shown in Table 4-13, TOC levels remained unchanged at 1.4 mg/L during the NaOCl jar test. Manganese levels also remained constant. Ammonia levels increased from 1.3 to 1.6 mg/L (as N). There is no plausible explanation for such an increase, and analytical errors may be the only probable cause. DO levels remained low at 1.0 mg/L (versus 0.9 mg/L in raw water); DO levels in the KMnO<sub>4</sub> jars also remained low at 1.1 to 1.2 mg/L. These, together with the presence of only soluble iron in raw water, suggest that the water collection method adequately preserved raw water quality during the study period.

The KMnO<sub>4</sub> demand study used 1.9, 4.2. and 6.6 mg/L of KMnO<sub>4</sub> (as KMnO<sub>4</sub>) in three separate jars. As shown in Table 4-12, KMnO<sub>4</sub> residual levels ranged from 0.9 to 5.0 mg/L, reflecting a demand of 1.0 to 1.6 mg/L (as KMnO<sub>4</sub>). This demand was somewhat lower than the amounts (from 1.6 to 2.2 mg/L) measured during the follow-on jar tests, probably because of the lower iron level in raw water (i.e., 2.1 versus 2.6 mg/L). In the presence of ammonia, KMnO<sub>4</sub> is a stronger and more effective oxidant than NaOCl because NaOCl reacts with ammonia to form chloramines.

Table 4-13. Jar Test Results for Arsenic and Iron Removal

				Oxidant	Dosage		
		Na(	OCI			nO <sub>4</sub>	
Analytes	Unit	0	2.2	0	1.9	4.2	6.6
Conta	ct Time	20	20	NM	20	20	20
рН	S.U.	7.4	7.0	NM	7.0	7.1	7.1
Temperature	°C	19.5	19.5	NM	19.6	19.8	19.9
DO	mg/L	0.9	1.0	NM	1.2	1.2	1.1
ORP	mV	-42	63	NM	237	373	463
Residual Oxidant	mg/L	0	0.1	NM	0.3	2.4	4.4
Oxidant Demand	mg/L	NA	>2.1	NM	1.6	1.7	2.2
NH <sub>3</sub> (as N)	mg/L	1.3	1.6	NM	1.2	1.2	1.1
TOC	mg/L	1.4	1.4	NM	1.4	1.2	1.1
As (total)	μg/L	29.9	30.7	NM	31.0	28.1	29.1
As (soluble)	μg/L	30.8	22.3	NM	7.4	6.2	6.6
As (particulate)	μg/L	0.0	8.4	NM	23.6	21.9	22.5
As(III)	μg/L	29.7	4.8	NM	1.5	0.7	0.9
As(V)	μg/L	1.1	17.5	NM	5.9	5.5	5.7
Fe (total)	μg/L	2,117	2,150	NM	2,677	2,654	2,663
Fe(soluble)	μg/L	2,111	730	NM	<25	<25	<25
Mn (total)	μg/L	121	122	NM	951	1,926	2,746
Mn (soluble)	μg/L	126	123	NM	178	426	1,133

DO = dissolved oxygen; NA = not available; NM = not measured; ORP = oxidation-reduction potential; TOC = total organic carbon

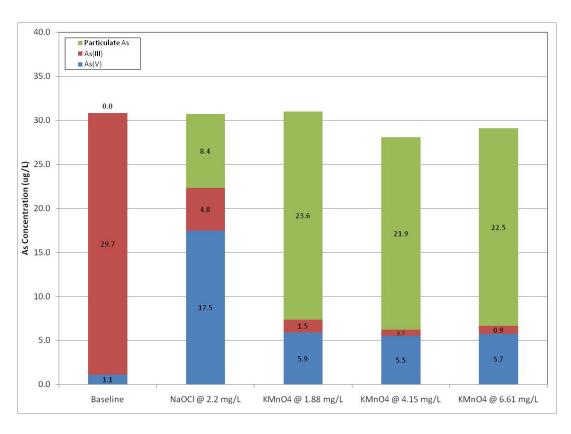


Figure 4-35. Arsenic Speciation Results for Samples Collected During Jar Tests

After 20 min of contact time, KMnO<sub>4</sub> reduced soluble arsenic, soluble As(III), and soluble As(V) to levels below 7.4, 1.5, and 5.9  $\mu$ g/L, respectively. Soluble iron was converted in its entirety to arsenic-laden iron solids, which can be removed by the Macrolite filters. As expected, ammonia concentrations remained constant at 1.1 to 1.2 mg/L, since it does not react with KMnO<sub>4</sub>. TOC levels were reduced somewhat, from 1.4 to 1.1 mg/L, as the KMnO<sub>4</sub> dosage increased from 1.9 to 6.6 mg/L.

Two key issues related to the use of KMnO<sub>4</sub> involved selecting and maintaining an initial dose and coping with changing water quality. With 2.6 mg/L of iron, 1.5 mg/L of KMnO<sub>4</sub> (as KMnO<sub>4</sub>) would be recommended, assuming that raw water would bypass the aeralater. Because TOC levels in raw water were marginally elevated, the need to increase KMnO<sub>4</sub> dose to "overcome" the TOC effect, as discussed in Section 2.3, might not exist. Also, overdosing KMnO<sub>4</sub> would impart pink color to and elevated manganese levels in the filter effluent. Any untreated soluble Mn(II) might be removed by the downstream synthetic zeolite.

4.5.2.4 Filter Run Length Study During January 2010 Site Visit. Figure 4-36 shows a time-series plot of arsenic, iron, and manganese breakthrough from Tank A, along with flowrate (Q) and  $\Delta p$  data shown next to the iron data points. Also present on the plot are horizontal lines indicating the arsenic MCL (10  $\mu$ g/L), manganese SMCL (50  $\mu$ g/L), and iron SMCL (300  $\mu$ g/L).

Total arsenic was measured at 14.8  $\mu$ g/L before the first hour of filter runtime, with most of the concentration (13.1  $\mu$ g/L) present in the soluble form. Total arsenic concentrations decreased slightly over the next 5 hr, with concentrations ranging from 11.6 to 12.4  $\mu$ g/L. Particulate arsenic concentrations remained relatively constant and ranged from 1.1 to 2.2  $\mu$ g/L. The quick breakthrough was obviously caused by the fact that arsenic existed primarily in the soluble form before entering the filters.

Total iron was measured at 270  $\mu$ g/L after the first hour of filter runtime. In contrast to the breakthrough of arsenic, almost all of the iron was in the particulate form. Total manganese was measured above the SMCL of 50  $\mu$ g/L after the first hour of filter runtime. This was to be expected, as all of the manganese present after chlorination was in the soluble form. Manganese measured throughout the run-length study ranged from 116 to 121  $\mu$ g/L, all of which was present in the soluble form.

The poor filter performance was expected because most arsenic that broke through from the filters existed as soluble arsenic and because iron particles prematurely broke through the filter beds most likely due to bio- and iron fouling of the filter media and shallow bed depths of the filters. The result of this run length study was consistent with what was observed during the performance evaluation study.

**4.5.3 Backwash Wastewater Sampling.** Table 4-14 presents analytical results of six backwash wastewater sampling events taking place prior to implementation of iron addition. Concentrations of TDS and total suspended solids (TSS) ranged from 326 to 474 mg/L and from 18 to 234 mg/L, respectively. Concentrations of total arsenic, iron, and manganese ranged from 110 to 468 μg/L, from 13.8 to 74.0 mg/L, and from 592 to 3,689 μg/L, respectively. As expected, these metals existed primarily in the particulate form. Average concentrations of particulate arsenic, iron, and manganese were 218 μg/L, 31.8 mg/L, and 1,464 μg/L, respectively. Assuming that these average particulate results existed during the production of 6,752 gal of wastewater per backwash event, approximately 0.01 lb of arsenic, 1.8 lb of iron, and 0.08 lb of manganese would be disharged during each backwash event. Using the average TSS concentration (87.8 mg/L), the total amount of solids discharged would be 4.9 lb. For all events, the backwash wastewater had a pH of 7.8 to 8.0.

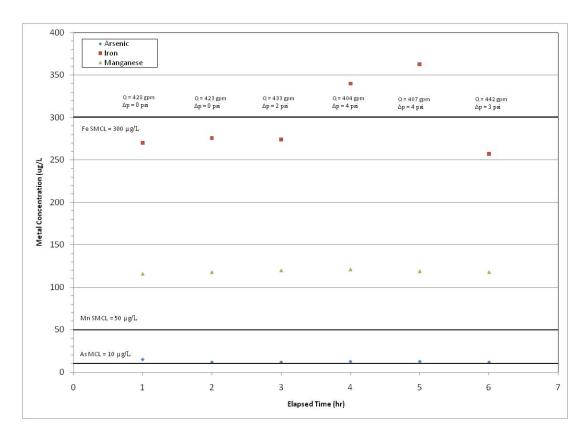


Figure 4-36. Arsenic, Iron, and Manganese Breakthrough During Filter Run-length Study

**4.5.4 Distribution System Water Sampling.** Table 4-15 summarizes the results of the distribution system sampling events. The water quality was similar among the three residences except for copper at the DS1 and DS3 residences, which exhibited higher concentrations than the other residence. After the treatment system began operation, arsenic concentrations remained essentially unchanged from the average baseline level of 15.6  $\mu$ g/L to 15.3  $\mu$ g/L. Iron and manganese concentrations increased slightly from baseline levels of <25 and 65.3  $\mu$ g/L to 47.2 and 96  $\mu$ g/L, respectively. Alkalinity, pH, and lead concentrations also increased slightly from average baseline levels of 296  $\mu$ g/L (as CaCO<sub>3</sub>), 7.1 S.U., and 0.4  $\mu$ g/L to 333  $\mu$ g/L (as CaCO<sub>3</sub>), 7.4 S.U., and 0.8  $\mu$ g/L, respectively. Copper concentrations increased rather significantly from the average baseline level of 108  $\mu$ g/L to 267  $\mu$ g/L, due mainly to four >1,000  $\mu$ g/L hits, including one over the 1,300- $\mu$ g/L action level (1,317  $\mu$ g/L). Otherwise, the water in the distribution system was comparable to that of the treatment system effluent. Thus, the treatment system appeared to have no beneficial effects on arsenic, manganese, and iron concentrations of the distribution system water.

## 4.6 System Cost

The system cost was evaluated based on the capital cost per gpm (or gpd) of design capacity and the O&M cost per 1,000 gal of water treated. Capital cost of the treatment system included cost for equipment, site engineering, and system installation, shakedown, and startup. O&M cost included cost for chemicals, electricity, and labor. Cost associated with the building including the sump, sanitary sewer connections, and water system telemetry was not included in the capital cost because it was not included in the scope of this demonstration project and was funded separately by United Water Systems.

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Table 4-14. Backwash Wastewater Sampling Test Results

						В	W1									]	BW2				
						Ves	sel A									V	essel B				
	ampling Event	Hd	TDS	LSS	As (total)	As (soluble)	As (particulate)	Fe (total)	Fe (soluble)	Mn (total)	Mn (soluble)	Hd	TDS	TSS	As (total)	As (soluble)	As (particulate)	Fe (total)	Fe (soluble)	Mn (total)	Mn (soluble)
No.	Date	S.U.	mg/L	mg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	S.U.	mg/L	mg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L
1	09/19/06	7.5	470	56	110	17.5	72.5	14,232	33.8	1,312	119	7.4	474	48	114	18.9	95.5	14,373	56.7	1,222	134
2	10/31/06	7.2	392	65	165	13.0	152	19,391	54.7	3,689	126	7.3	410	50	128	13.6	114	13,779	81.2	2,732	145
3	01/15/07	7.5	360	45	213	16.4	197	28,167	59.9	1,334	32.1	7.4	374	18	224	15.6	208	29,562	68.4	1,446	86.5
4	02/14/07	7.6	360	32	137	24.6	113	15,439	52.3	592	58.8	7.5	362	102	225	28.3	197	26,083	22.8	896	52.0
5	02/26/07	7.7	340	136	279	19.8	259	35,973	<25	956	87.8	7.8	326	113	418	19.0	399	59,262	<25	1,308	95.4
6	03/25/07	7.5	392	234	468	14.8	453	73,957	<25	1,965	86.9	7.5	400	154	348	14.8	363	51,976	<25	1,222	88.1

TDS = total dissolved solids; TSS = total suspended solids

**Table 4-15. Distribution System Sampling Results** 

	Address				DS	81							DS	52							DS	33			
	Sample																								
	Type				LC	R							LC	R							LC	R			
	Flushed/																								
	1st Draw		1		1st D	raw		1	1			1	1st D	raw	1	1					1st D	raw		1	
No. of Sampling Events	Sampling Date	Stagnation Time (hr)	рн (S.U.)	Alkalinity (mg/L as CaCO <sub>3</sub> )	As (µg/L)	Fe (µg/L)	Mn (μg/L)	Pb (μg/L)	Cu (µg/L)	Stagnation Time (hr)	рН (S.U.)	Alkalinity (mg/L as CaCO <sub>3</sub> )	As (µg/L)	Fe (µg/L)	Mn (µg/L)	Pb (μg/L)	Cu (µg/L)	Stagnation Time (hr)	рН (S.U.)	Alkalinity (mg/L as CaCO <sub>3</sub> )	As (µg/L)	Fe (µg/L)	Mn (μg/L)	Pb (μg/L)	Cu (µg/L)
BL1	08/03/05 <sup>(a)</sup>	6.2	7.1	295	20.1	<25	74.1	0.2	123	10.3	7.1	299	18.3	<25	78.2	0.8	161	8.0	7.0	295	18.6	<25	79.5	0.2	150
BL2	10/05/05	7.3	6.7	308	13.1	<25	68.3	< 0.1	37.7	NA	7.1	308	12.9	<25	68.1	0.7	285	6.1	7.2	330	12.6	<25	70.4	0.4	279
BL3	11/30/05	7.8	7.0	286	15.3	<25	60.9	0.7	9.6	8.0	7.0	286	16.2	<25	52.4	0.3	123	$0.0^{(b)}$	7.1	290	14.6	<25	53.6	0.5	13.3
BL4	01/31/06	NA	7.3	286	15.8	<25	68.1	0.4	36.2	NA	7.3	286	15.7	<25	52.5	0.6	38.2	NA	7.3	286	14.5	<25	57.7	0.2	33.9
1	09/11/06 <sup>(c)</sup>	NS	NS	NS	NS	NS	NS	NS	NS	10.5	7.4	344	11.3	<25	214	1.9	268	12.0	7.3	333	12.2	<25	235	0.3	22.5
2	10/04/06	NA	7.2	323	20.7	<25	123	0.2	34.8	NA	7.2	323	20.7	<25	135	< 0.1	21.1	0.2	7.2	325	20.7	<25	125	< 0.1	5.0
3	11/15/06	7.5	7.2	318	8.1	<25	52.0	0.1	21.2	NA	7.2	330	11.9	<25	101	1.7	32.4	8.0	7.2	320	8.9	<25	76.2	1.3	1,317
4	01/03/07	7.0	7.5	357	14.0	<25	133	< 0.1	17.6	NA	7.6	351	16.1	43.2	105	3.1	33.6	9.0	7.6	361	13.5	<25	159	1.2	1,250
5	01/24/07	7.5	7.5	328	17.6	<25	54.8	< 0.1	44.7	NA	7.4	322	21.4	<25	47.8	0.4	16.1	8.0	7.4	335	18.4	<25	53.3	0.2	331
6	02/08/07	6.5	7.6	352	16.5	<25	67.2	0.1	13.3	NA	7.5	340	19.1	658	161	1.3	21.1	6.5	7.6	332	15.6	38.0	70.3	1.3	174
7	03/13/07	7.0	7.4	328	13.8	<25	67.0	< 0.1	74.4	NA	7.4	333	14.2	<25	51.4	1.4	25.2	NA	7.5	338	12.5	<25	71.4	1.0	1,071
8	04/03/07	6.0	7.5	320	12.9	<25	39.8	1.3	1,286	9.4	7.4	323	15.9	109	33.0	1.8	35.7	8.0	7.36	325	16.9	<25	34.0	0.1	21.0

<sup>(</sup>a) DS1, DS2, and DS3 samples switched for this sampling event; correct results displayed in table.

<sup>(</sup>a) BS1, BS2, and BS3 samples switched for this sampling event, correct results displayed
(b) No time lapsed.
(c) DS3 sample collected on 9/12/06 at 1026 another location on LCR sampling network.
BL = baseline sampling; NA = not available; NS = not sampled
Lead action level = 15 μg/L; copper action level = 1.3 mg/L

**4.6.1 Capital Cost.** The capital investment for the FM-284-AS system was \$427,407 (Table 4-16). The equipment cost was \$281,048 (or 66% of the total capital investment), which included cost for two, 84-in × 96-in steel pressure vessels and associated distributors, 150 ft<sup>3</sup> of Macrolite® media, process valves and piping, air scour system, chemical feed, instrumentation and controls, turbidimeter, and additional sample taps and totalizer/meters, shipping, labor, and system warranty. The system warranty covered the cost for repair and replacement of defective system components and installation workmanship for 12 months after system startup.

Table 4-16. Capital Investment for Kinetico's FM-284-AS System

D	6. 1	% of Capital
Description	Cost	Investment Cost
Equipment		
Welded Stainless Steel Frame	\$13,951	_
84-in × 96-in Steel Pressure Vessels	\$59,579	
Wedge Wire Distributors – 84 in Vessels	\$16,543	
Macrolite® Media (150 ft³)	\$37,500	_
Process Valves and Piping	\$47,797	
Air Scour System	\$9,830	_
Chemical Feed System	\$6,750	_
Instrumentation and Controls	\$18,556	_
Turbidimeter	\$6,612	
Additional Sample Taps and Totalizers/Meters	\$1,700	_
Labor	\$54,824	_
Freight	\$7,406	_
Equipment Total	\$281,048	66%
Engineering		
Labor	\$44,520	_
Subcontractor	\$6,250	_
Engineering Total	\$50,770	12%
Installation, Shakedown, a	and Startup	
Labor	\$90,804	_
Subcontractor	\$0	_
Travel	\$4,785	_
Installation, Shakedown, and Startup	\$95,589	22%
Total Capital Investment	\$427,407	100%

The site engineering cost covered the cost for preparing the required permit application submittal, including a process design report, a general arrangement drawing, piping and instrumentation diagrams, electrical diagrams, interconnecting piping layouts, tank fill details, and a schematic of the PLC panel, and obtaining the required permit approval from LADHH/OPH. The engineering cost of \$50,770 was 12% of the total capital investment.

The installation, shakedown, and startup cost covered the labor and materials required to unload, install, and test the system for proper operation. All activities were performed by the vendor with the operator's assistance. The installation, startup, and shakedown cost of \$95,589 was 22% of the total capital investment.

The total capital cost of \$427,407 was normalized to \$555/gpm (\$0.38/gpd) of design capacity using the system's rated capacity of 770 gpm (or 1,108,800 gpd). The total capital cost also was converted to an

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annualized cost of \$40,343 gal/yr using a capital recovery factor (CRF) of 0.09439 based on a 7% interest rate and a 20-yr return period. Assuming that the system operated 24 hr/day, 7 day/week at the design flowrate of 770 gpm to produce 404,712,000 gal/yr, the unit capital cost would be \$0.10/1,000 gal. During the four-year study period, the system average daily demand was 277,128 gal, or 101,151,720 gal annually, so the unit capital cost increased to \$0.40/1,000 gal.

A 53 ft  $\times$  25 ft pre-engineered metal building with a roof height of 16 ft was installed by United Water Systems to house the treatment system (Section 4.3.2). The cost of the building and supporting utilities was not included in the capital investment.

**4.6.2 O&M** Cost. O&M costs included chemical usage, electricity consumption, and labor as shown in Table 4-17. Three chemicals were used for treatment, including chlorine, KMnO<sub>4</sub>, and FeCl<sub>3</sub>. Since chlorination already existed prior to the demonstration study, its incremental cost for pre- and/or post-treatment was not tracked during the study. Addition of FeCl<sub>3</sub> was implemented from December 2007 through July 2009. However, the effect of iron addition was inconclusive due to erratic FeCl<sub>3</sub> dosage and aeration in the aeralater; the addition was terminated in July 2009. Thus, there was no need to include FeCl<sub>3</sub> addition in the cost analysis. KMnO<sub>4</sub> had been used since system startup through the end of January 2007 and its use resumed after the aeralater was bypassed in April 2010. Based on the average KMnO<sub>4</sub> dosage of 1.8 mg/L used in the study and a unit cost of \$1.98/lb, the KMnO<sub>4</sub> usage was estimated to be \$0.03/1,000 gal.

Table 4-17. O&M Costs for Kinetico's FM-284-AS System

Category	Value	Remarks
Annual Volume Processed		Based on daily demand of 277,128 gal for study
$(gal \times 10^6)$	101	period from 07/17/06 through 09/16/10
	Chemica	l Usage
Chlorine Cost (\$/1,000 gal)	NA	Existed prior to the demonstration study
FeCl <sub>3</sub> Cost (\$/1,000 gal)	NA	Inconclusive; terminated in July 2009
KMnO <sub>4</sub> Consumption (lb/1,000 gal)	0.015	Based on an average dosage of 1.8 mg/L
Chemical Cost (\$/1,000 gal)	0.03	Based on a unit cost of \$1.98/lb
	Electricity Co	onsumption
Electricity Cost (\$/1,000 gal)	Negligible	
	Lab	or
Labor (hr/week)	2.5	30 min/day, 5 day/week
Labor Cost (\$/1,000 gal)	\$0.04	Labor rate = \$30/hr
Total O&M Cost (\$/1,000 gal)	\$0.07	

Electrical power consumption associated with the chemical feed system was assumed to be negligible. The routine, non-demonstration related labor activities consumed 30 min/day, five days a week. Based on this time commitment and a labor rate of \$30/hr, the labor cost was \$0.04/1,000 gal of water treated. In sum, the total O&M cost was estimated to be \$0.07/1,000 gal. It should be noted that this low O&M cost did not include any costs associated with the extensive system troubleshooting by the operator, such as performing the acid/caustic wash of the fouled media, replenishing the Macrolite® media, and modifying the existing aeralater piping configuration.

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## APPENDIX A OPERATIONAL DATA

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet

Г																	Pressure F	iltration								Pack	wash			
										KMnO <sub>4</sub>							i leasule i	iiiiauoii					ļ			Dack	wasii	Since I	Last BW	
									KMnO <sub>4</sub>	Tank 2	Estimated											Daily					Run	Run	Standby	Standby
					Tank A Hour	Tank B Hour Meter	TA Run	TB Run	Tank 1	Level	KMnO <sub>4</sub>	Influent	Outlet	Outlet	Effluent	Inlet-TA		Inlet- Effluent	Flow	Totalizer to Distribution	Gallon	Average	Tank	Tank R	Total	Daily	Time	Time	Time	Time
We		Day of Week	Date	Time	Meter hrs	Meter	Time	Time	inches	(Iron) inches	Dosage µg/L as Mn	Influent	Tank A psig	Tank B	Effluent	Inlet-TA psia	Inlet-TB psig	Effluent	rate gpm	Distribution	Usage	Flowrate	A No.	No.	Volume kgal	Volume kgal	Tank A	Tank B hrs	Tank A	Tank B hrs
-"	<del>"</del>		07/17/06	7:33 AM	279.3	NR	NA	NA	NR	NR	NA NA	34	25	24	20	9	10	14	377	179.9	NA NA	NA NA	NR	NR	NR	NA	3.7	NR	5.9	NR
	□	Tue	07/18/06	10:23 AM	293.4	NR	14.1	NA	NR	NR	NA	35	19	19	19	16 NA	16	16	340	467.7	287,800	#VALUE!	NR	NR	NR	NA	8.3	NR	9.0	NR
Ι,	. H	Wed Thu	07/19/06	8:30 AM 7:50 AM	NR 315.4	NR NR	NA 22.0	NA NA	NR NR	NR NR	NA NA	34 34	NR 25	NR 24	NR 23	NA 9	10	11	430 370	NR 976.6	508,900	#VALUE!	NR NR	NR NR	NR NR	NA NA	0.3 3.9	NR NR	0.4 6.5	NR NR
	Ė	Fri	07/21/06	7:03 AM	325.2	NR	9.8	NA	NR	NR	NA	35	22	21	19	13	14	16	346	1,198.9	222,300	#VALUE!	NR	NR	NR	NA	5.7	NR	7.8	NR
	F	Sat	07/22/06	7:49 AM	337.2	NR	12.0	NA	NR	NR	NA	33	25	24	20	8	9	13 19	389	1,474.9	276,000	#VALUE!	NR	NR	NR	NA	2.8	NR	6.3	NR
-	+	Sun	07/23/06	9:47 AM NR	351.2 NR	NR NR	14.0 NA	NA NA	NR NR	NR NR	NA NA	37 NR	NR	28 NR	18 NR	NA NA	NA NA	NA NA	296 NR	1,785.2 NR	310,300 NA	#VALUE!	NR NR	NR NR	NR NR	NA NA	0.3 NR	NR NR	0.0 NR	NR NR
		Tue	07/25/06	8:00 AM	374.4	NR	23.2	NA	NR	NR	NA	36	20	21	23	16	15	13	332	2,311.5	526,300	#VALUE!	NR	NR	NR	NA	6.3	NR	6.0	NR
Ι,	. F	Wed	07/26/06	10:00 AM	386.7 396.6	NR NR	12.3 9.9	NA NA	NR NR	NR NR	NA NA	32 36	22	23 27	22	10 10	9	10	400 340	2,593.6 2,815.8	282,100	#VALUE!	NR NR	NR NR	NR NR	NA NA	2.6 4.4	NR NR	0.9 6.5	NR NR
-   '	'⊢	Fri	07/27/06	9:00 AM 9:00 AM	410.4	NR NR	13.8	NA NA	NR NR	NR NR	NA NA	35	26 19	19	26 20	16	16	10	340	3,077.1	222,200 261,300	#VALUE!	NR	NR NR	NR NR	NA NA	8.2	NR NR	6.0	NR NR
		Sat	07/29/06	7:30 AM	419.9	NR	9.5	NA	NR	NR	NA	35	19	20	20	16	15	15	355	10,016.7	NA	#VALUE!	NR	NR	NR	NA	7.1	NR	9.0	NR
_	_	Sun	07/30/06	7:30 AM	433.9 446.0	NR NR	14.0 12.1	NA NA	NR NR	NR NR	NA NA	32 34	22	23	22	10 12	9 12	10 12	390	10,291.8 10,569.0	275,100	#VALUE!	NR NR	NR	NR NR	NA NA	NR 5.3	NR NR	NR 6.5	NR NR
	H	Tue	08/01/06	7:10 AM 7:20 AM	458.3	NR NR	12.1	NA NA	NR NR	NR	NA NA	38	22 23	22	23	15	16	15	362 285	10,832.4	277,200 263.400	#VALUE!	NR	NR NR	NR NR	NA NA	8.2	NR	8.0	NR
	E	Wed	08/02/06	7:26 AM	469.5	NR	11.2	NA	NR	NR	NA	33	26	26	21	7	7	12	375	11,079.9	247,500	#VALUE!	NR	NR	NR	NA	1.5	NR	0.0	NR
-   '	'⊢	Thu Fri	08/03/06	7:27 AM 7:55 AM	481.7 494.2	NR NR	12.2 12.5	NA NA	NR NR	NR NR	NA NA	35 30	22	21 22	20	13 6	14 8	15 10	340 412	11,350.5 11.621.2	270,600 270,700	#VALUE!	NR NR	NR NR	NR NR	NA NA	5.2 0.1	NR NR	5.7 0.0	NR NR
	F	Sat	08/05/06	8:40 AM	506.7	NR	12.5	NA NA	NR	NR	NA NA	34	22	21	21	12	13	13	356	11,898.6	277,400	#VALUE!	NR	NR	NR	NA NA	5.2	NR	7.2	NR
		Sun	08/06/06	9:30 AM	519.3	NR	12.6	NA	NR	NR	NA	NR	NR	NR	NR	NA	NA	NA	420	12,178.9	280,300	#VALUE!	NR	NR	NR	NA	1.9	NR	0.2	NR
	⊢	Mon Tue	08/07/06	7:20 AM 7:30 AM	529.7 541.5	NR NR	10.4 11.8	NA NA	NR NR	NR NR	NA NA	34 36	23	22	21 21	11 14	12 15	13 15	370 331	12,408.9 12.653.0	230,000 244,100	#VALUE!	NR NR	NR NR	NR NR	NA NA	2.8 6.7	NR NR	5.6 7.8	NR NR
		Wed	08/08/06	7:20 AM	554.2	NR.	12.7	NA NA	NR	NR	NA NA	33	25	23	22	8	10	11	380	12,033.0	279,000	#VALUE!	NR	NR	NR	NA NA	1.8	NR	1.1	NR
	F	Thu	08/10/06	11:46 AM	569.1	570.4	14.9	NA	NR	NR	NA	NR	NR	NR	NR	NA	NA	NA	NR	13,256.2	324,200	#VALUE!	68	68	556.4	NA	8.0	1.4	0.4	0.4
	-	Fri Sat	08/11/06	7:33 AM 9:00 AM	578.6 590.5	579.8 591.6	9.5 11.9	9.4 11.8	NR NR	NR NR	NA NA	36 37	26 20	26 19	19 12	10 17	10 18	17 25	330 325	20,183.9 20,441.2	NA 257,300	#VALUE!	69 70	69 70	564.3 572.6	7.9 8.3	3.0 6.6	3.0 7.2	3.7 8.4	4.4 8.1
	F	Sun	08/13/06	10:46 AM	604.1	605.2	13.6	13.6	NR	NR	NA NA	34	21	22	14	13	12	20	344	20,736.7	295,500	362	72	72	604.1	31.5	4.0	3.4	5.0	4.9
		Mon	08/14/06	7:03 AM	614.4	616.0	10.3	10.8	NR	NR	NA	37	19	20	11	18	17	26	323	20,963.0	226,300	358	73	73	614.9	10.8	6.3	5.8	6.0	6
	⊢	Tue Wed	08/15/06	7:04 AM 7:28 AM	631.6 642.6	624.8 630.8	17.2 11.0	6.0	NR 26.5	NR NR	NA NA	37 31	28 18	55 14	10	9	NA 17	27 31	305 385	21,285.3 21,499.2	322,300 213,900	461 459	80	74 74	630.1 663.8	15.2 33.7	1.2 0.0	0.0	0.0	0.0
:	· L	Thu	08/17/06	8:00 AM	653.2	641.0	10.6	10.2	31.5	NR	NA	30	17	16	0	13	14	30	411	21,780.9	281,700	452	92	75	678.2	14.4	2.7	3.3	6.5	6.6
	<u> </u>	Fri Sat	08/18/06	7:30 AM 7:00 AM	662.8 671.5	650.5 659.2	9.6 8.7	9.5 8.7	29.3 23.5	NR NR	NA NA	25 30	18 17	18 17	0	7	7 13	25 30	440 424	22,029.4 22,254.9	248,500 225,500	434 432	94	77 78	692.1 699.6	13.9 7.5	1.5 2.9	0.9 3.5	0.6 7.0	0.6 7.0
	⊢	Sun	08/20/06	7:00 AM	682.6	670.3	11.1	11.1	25.0	NR NR	NA NA	28	17	17	0	13	11	28	440	22,254.9	280,400	432	95 97	80	714.4	14.8	2.9	2.6	7.0	7.0
		Mon	08/21/06	7:03 AM	697.2	681.2	14.6	10.9	31.0	NR	NA	26	21	16	0	5	10	26	466	22,877.2	341,900	457	103	81	739.4	25.0	0.9	0.1	0.0	0.0
	-  -	Tue Wed	08/22/06	7:11 AM 7:09 AM	711.1 722.6	688.1 696.4	13.9	6.9	28.0 22.0	NR NR	NA NA	5 30	16	11	0	NA 14	NA 12	NA 30	NR 432	23,178.0 30,171.6	300,800 NA	544 #VALUE!	112	81 81	770.5 777.3	31.1 6.8	0.0 4.0	0.1	0.0 5.4	0.2
- 1 :	.  -	Thu	08/24/06	7:14 AM	732.9	706.0	10.3	9.6	23.5	NR	NA NA	25	19	19	0	6	6	25	470	30,430.5	258,900	434	116	83	791.3	14.0	0.7	1.3	0.0	0.0
		Fri	08/25/06	6:55 AM	742.0	715.1	9.1	9.1	22.0	NR	NA	30	17	17	0	13	13	30	413	30,663.9	233,400	427	117	84	798.3	7.0	3.2	3.6	6.7	6.7
	H	Sat	08/26/06	7:20 AM 9:00 AM	753.1 763.5	725.7 736.2	11.1 10.4	10.6 10.5	27.0 27.0	NR NR	NA NA	NR 31	NR 16	NR 17	0	NA 15	NA 14	NA 31	462 400	30,929.2 31,191.8	265,300 262,600	408 419	119 120	86 87	812.3 819.9	14.0 7.6	0.6 4.3	0.8 3.6	1.1 7.9	1.3 7.9
	_	Mon	08/28/06	6:54 AM	774.1	768.1	10.6	31.9	24.3	NR	NA	32	19	18	5	13	14	27	399	31,433.8	242,000	253	122	88	831.7	11.8	2.8	3.4	6.2	6.2
	F	Tue	08/29/06	7:08 AM	786.9	759.6	12.8	NA	29.5	NR	NA	28	20	20	5	8	8	23	237	31,732.9	299,100	#VALUE!	124	90	846.6	14.9	1.1	0.5	0.0	0.0
Ι.		Wed Thu	08/30/06	6:53 AM 6:56 AM	799.0 811.7	772.3 784.5	12.1 12.7	12.7 12.2	27.5 24.5	NR NR	NA NA	28 34	20 18	19 17	5	8 16	9 17	23 29	434 361	32,029.1 32,319.1	296,200 290,000	398 388	126 127	92 93	863.8 874.1	17.2 10.3	1.3 5.1	1.3 5.7	1.3 5.6	0.7 5.6
		Fri	09/01/06	7:03 AM	822.5	795.0	10.8	10.5	25.0	NR	NA NA	29	20	19	5	9	10	24	425	32,575.2	256,100	401	129	95	891.5	17.4	1.5	1.5	3.3	3.9
	<u> </u>	Sat	09/02/06	8:58 AM 9:21 AM	833.0 843.7	805.4	10.5	10.4	24.5	NR NR	NA NA	33	18	17 20	5	15 9	16 9	28	377 417	32,823.7	248,500	396	130	96 98	900.0 914.4	8.5 14.4	3.9	4.5 0.1	8.2 1.6	8.2 1.4
-	-	Mon	09/03/06	9:21 AM 8:35 AM	843.7 853.9	816.1 826.6	10.7 10.2	10.7	24.5 22.0	NR NR	NA NA	29	20	20	0	NA NA	NA NA	24 NA	417	33,082.4 40,047.1	258,700 NA	#VALUE!	132		914.4	7.5	1.2 5.2	4.6	8.3	8.3
	L	Tue	09/05/06	6:54 AM	865.4	838.2	11.5	11.6	24.0	NR	NA NA	34	18	18	5	16	16	29	381	40,329.1	282,000	407	135	101	940.6	18.7	4.5	3.9	6.9	6.8
	.  -	Wed	09/06/06 09/07/06	7:05 AM 6:58 AM	876.2 886.8	844.3 860.0	10.8	6.1	27.0 27.0	NR NR	NA NA	31 29	20 21	19 19	5	11 8	12 10	26 24	470 425	40,600.3 40,864.2	271,200 263,900	580 348	137	103 105	958.0 975.0	17.4 17.0	2.3 0.7	2.9	5.8 0.8	5.8 0.7
-   '	'⊢	Fri	09/08/06	7:00 AM	899.0	872.4	12.2	12.4	27.0	NR	NA NA	28	22	19	5	6	9	23	426	41,159.2	295,000	400	141	107	993.0	18.0	0.7	1.1	0.0	0.0
		Sat	09/09/06	7:10 AM	908.6	882.0	9.6	9.6	25.0	NR	NA	32	19	18	5	13	14	27	401	41,397.0	237,800	413	142	108	1002.3	9.3	4.2	4.8	7.3	7.4
-	_	Sun	09/10/06	7:05 AM 6:59 AM	919.5 931.6	892.9 904.9	10.9 12.1	10.9 12.0	25.0 34.0	NR NR	NA NA	30 29	20 19	18 19	5	10 10	12 10	25 24	416 425	41,663.7 41,953.6	266,700 289,900	408 401	144	110	1020.0 1043.2	17.7 23.2	2.1	2.7	7.7	7.6
	F	Tue	09/11/06	7:03 AM	942.8	916.2	11.2	11.3	27.0	NR	NA NA	5	12	11	5	NA NA	NA NA	NA	0	42,212.2	258,600	383	149	113	1043.2	15.3	5.8	5.0	7.2	7.2
		Wed	09/13/06	7:20 AM	953.6	927.0	10.8	10.8	26.0	NR	NA	33	19	19	5	14	14	28	382	42,472.4	260,200	402	149	115	1079.0	20.5	3.2	2.5	5.3	5.4
-   '	' ├	Thu Fri	09/14/06	6:59 AM 6:57 AM	963.0 973.6	936.4 947.4	9.4	9.4 11.0	25.0 20.0	NR NR	NA NA	36 33	17 18	18 19	5	19 15	18 14	31 28	340 393	42,690.6 42,954.5	218,200 263,900	387 407	150 152	116 118	1090.2 1116.2	11.2 26.0	5.5 4.1	4.9 3.5	6.7 6.0	6.7 6.0
	t	Sat	09/16/06	10:00 AM	988.3	962.1	14.7	14.7	22.0	NR	NA	37	17	18	5	20	19	32	343	50,018.3	NA	#VALUE!	154	120	1138.7	22.5	5.1	4.4	1.9	1.9
$\vdash$	_[	Sun	09/17/06	9:30 AM	998.6	969.5	10.3	7.4	24.0	NR	NA	27	20	21	5	7	6	22	431	50,191.6	173,300	335	156	122	1161.5	22.8	0.9	0.4	0.0	0.0
	F	Mon Tue	09/18/06	7:42 AM 7:08 AM	1,006.5 1.016.6	981.1 990.9	7.9 10.1	11.6 9.8	23.0 19.8	NR NR	NA NA	37 30	27 20	1 19	5	10 10	NA 11	32 25	315 417	50,455.5 50,698.6	263,900 243,100	468 407	158 159	123 124	1179.5 1201.9	18.0 22.4	0.1 2.2	0.0 2.2	0.0 5.4	0.0 4.9
	t	Wed	09/20/06	4:25 AM	1,010.0	1,004.4	13.6	13.5	14.0	NR	NA NA	33	12	11	5	21	22	28	391	51,015.0	316,400	389	160	126	1228.9	27.0	5.7	5.1	4.3	4.2
	· [	Thu	09/21/06	7:03 AM	1,041.0	1,015.2	10.8	10.8	18.0	NR	NA	32	20	17	5	12	15	27	378	51,279.2	264,200	408	164	130	1253.4	24.5	3.2	3.9	5.6	5.6
	F	Fri Sat	09/22/06 09/23/06	7:00 AM 9:00 AM	1,051.4 1,061.7	1,025.7 1,035.9	10.4 10.3	10.5 10.2	16.5 15.0	NR NR	NA NA	29 37	21 36	19 26	5	8 NA	10 11	24 32	422 400	51,525.3 51,774.3	246,100 249,000	393 405	166 167	132 134	1274.8 1295.1	21.4	1.5 0.0	2.2 0.4	5.4 0.0	5.5 0.0
		Sun	09/24/06	9:45 AM	1,072.6	1,047.1	10.9	11.2	18.5	NR	NA NA	35	17	17	5	18	18	30	327	52,038.5	264,200	399	169	135	1310.2	15.1	4.8	5.4	8.1	8.1
	F	Mon	09/25/06	7:00 AM	1,083.4	1,057.7	10.8	10.6	9.5	7.0	522	31	19	20	5	12 NA	11 10	26	420	52,296.8	258,300	402	171	137 139	1333.1	22.9	3.5	2.8	6.2	6.2
	ŀ	Tue Wed	09/26/06 09/27/06	7:01 AM 7:04 AM	1,094.6 1.107.0	1,068.7 1,080.8	11.2 12.4	11.0 12.1	9.5 8.0	7.0 10.0	542 509	37 37	2	27 27	5 	NA NA	10 10	32 32	308 306	52,546.0 52,835.5	249,200 289,500	374 394	172 174		1350.7 1376.2	17.6 25.5	0.0	0.1	0.0	0.0
	Ŀ	Thu	09/28/06	6:59 AM	1,119.6	1,093.9	12.6	13.1	9.5	7.0	1078	40	31	30	5	9	10	35	268	53,148.4	312,900	406	177	143	1400.4	24.2	2.8	3.3	5.5	5.5
	-  -	Fri Sat	09/29/06	6:53 AM 7:10 AM	1,130.0 1.139.7	1,104.3 1.114.2	10.4 9.7	10.4 9.9	9.5 7.0	6.5 8.5	NA 523	32 31	20 21	19 19	5	12 10	13 12	27 26	406 411	60,128.9 60.371.5	NA 242.600	#VALUE!	179 181	145 147	1418.2 1438.7	17.8 20.5	2.8	3.4 2.6	6.3 6.4	6.1 6.5
		Sun	10/01/06	7:10 AM 7:25 AM	1,139.7	1,114.2	12.1	11.3	7.0	9.0	497	31	20	19	5	10	12	26	382	60,635.0	263,500	413 376	183	147	1438.7	17.7	2.8	3.4	7.4	7.4

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet (Continued)

									KMnO₄							Pressure F	iltration								Baci	wash	Since I	Last BW	
								KMnO <sub>4</sub>	Tank 2	Estimated											Daily					Run	Run	Standby	Standby
Week	Day of			Tank A Hour Meter	Tank B Hour Meter	TA Run Time	TB Run Time	Tank 1 Level <sup>(a)</sup>	Level (Iron)	KMnO <sub>4</sub> Dosage	Influent	Outlet Tank A	Outlet Tank B	Effluent	Inlet-TA	Inlet-TB	Inlet- Effluent	Flow	Totalizer to Distribution	Gallon Usage	Average Flowrate	Tank A	Tank	Total Volume	Daily Volume	Time Tank A	Time Tank B	Time Tank A	Time Tank B
No.	Week	Date	Time	hrs	hrs	hrs	hrs	inches		μg/L as Mn	psig	psig	psig	psig	psig	psig	psig	gpm	kgal	gal	gpm	No.	No.	kgal	kgal	hrs	hrs	hrs	hrs
	Mon Tue	10/02/06	6:54 AM 7:03 AM	1,163.0 1 174.0	1,137.5	11.2 11.0	12.0 11.0	8.0 8.0	7.5	448 437	35 34	18 18	17 18	5 5	17 16	18 16	30 29	353 363	60,917.9 61.180.1	282,900 262,200	407 397	185 187	151 153	1477.4 1496.6	21.0 19.2	4.6 4.8	5.3	6.3	6.3
	Wed	10/04/06	7:01 AM	1,186.0	1,160.3	12.0	11.8	8.0	6.8	429	27	20	20	5	7	7	22	433	61,461.5	281,400	394	190	156	1526.8	30.2	0.9	0.0	0.9	0.6
9	Thu	10/05/06 10/06/06	6:50 AM 7:04 AM	1,198.5 1,209.5	1,172.4 1,183.4	12.5 11.0	12.1 11.0	9.0 7.5	7.0 5.8	470 410	30 39	19 32	20 31	5 5	11 7	10 8	25 34	409 279	61,740.1 62,004.2	278,600 264,100	378 400	192 194	158 160	1545.8 1564.8	19.0 19.0	2.5 2.7	2.5 3.4	5.1 5.5	5.6 5.5
	Sat	10/07/06	9:50 AM	1,221.5	1,194.2	12.0	10.8	7.0	7.5	399	35	25	27	5	10	8	30	300	62,301.4	297,200	436	197	163	1586.3	21.5	4.6	5.3	6.3	6.3
_	Sun	10/08/06	9:04 AM 7:00 AM	1,232.6 1,244.8	1,206.6 1,219.1	11.1 12.2	12.4 12.5	7.0 7.5	7.5 6.5	417 387	38 30	19 21	19 21	5 5	19 9	19 9	33 25	320 429	62,585.5 62,881.0	284,100 295,500	404 399	200	166 169	1608.1 1629.1	21.8 21.0	1.9 2.0	1.9 2.0	3.8	4.3
	Tue	10/10/06	6:42 AM	1,256.1	1,230.2	11.3	11.1	6.5	5.5	369	43	20	0	5	NA	NA	38	226	63,147.1	266,100	396	205	171	1644.9	15.8	4.7	0.0	6.0	0.0
10	Wed	10/11/06	7:00 AM 6:48 AM	1,267.2	1,241.5	11.1	11.3 10.6	7.0 8.5	5.5 8.5	15 515	30 30	20	19 20	5	10 10	11 10	25 25	318 418	70,148.8 70,418.7	7,001,700 269,900	10,420 417	208	174	1667.3 1689.5	22.4	2.8 1.7	3.4 1.7	6.2 3.3	6.2 3.8
	Fri	10/13/06	7:05 AM	1,289.9	1,263.7	11.7	11.6	10.0	14.0	716	34	19	17	5	15	17	29	365	70,692.9	274,200	392	213	179	1704.1	14.6	2.9	3.4	5.0	5.0
	Sat	10/14/06	8:30 AM 9:33 AM	1,301.1	1,274.6 1,286.9	11.2 11.9	10.9 12.3	14.0 15.0	10.0 11.5	705 766	35 43	19	20 19	5	16 NA	15 NA	30 38	412 244	70,971.2 71.254.2	278,300 283,000	420 390	216 218	182 184	1725.0 1739.3	20.9	1.7 0.0	1.6 3.9	0.9	1.4 7.9
	Mon	10/16/06	7:10 AM	1,324.6	1,298.0	11.6	NA	11.0	13.5	735	29	22	19	5	7	10	24	418	71,526.9	272,700	#VALUE!	221	187	1761.4	22.1	1.4	1.7	1.7	1.9
	Tue	10/17/06	7:28 AM 7:30 AM	1,334.8 1,345.7	1,307.9 1,318.7	10.2 10.9	9.9	11.0 13.0	18.0 24.5	970 1145	32 27	20	18 20	5	12	14 7	27 22	381 440	71,771.3 72,039.1	244,400 267.800	405 411	223 226	189 192	1776.7 1807.3	15.3 30.6	1.8 0.6	1.2	3.4 0.0	3.6 0.0
11	Thu	10/19/06	7:30 AM	1,356.9	1,330.0	11.2	11.3	12.0	20.0	NA	31	19	20	5	12	11	26	407	2,294.9	NA	#VALUE!	228	194	1825.9	18.6	2.4	3.0	5.3	5.1
	Fri Sat	10/20/06	7:00 AM 7:05 AM	1,368.0 1.376.6	1,341.2 1,340.4	11.1 8.6	11.2 NA	12.0 10.0	17.0 14.5	880 912	31 30	18 20	18 22	5	13 10	13 8	26 25	345 402	2,564.3 2.783.9	269,400 219,600	#VALUE!	230	196 199	1844.8 1865.7	18.9 20.9	5.3 2.6	4.7 1.1	5.1 6.0	5.1 4.4
	Sun	10/22/06	7:15 AM	1,387.5	1,360.3	10.9	NA	11.5	14.5	817	33	19	19	5	10	14	28	388	3,044.3	260,400	#VALUE!	234	201	1882.6	16.9	3.3	2.8	7.7	7.8
	Mon Tue	10/23/06 10/24/06	7:10 AM 7:30 AM	1,399.8 1,410.2	1,372.8 1,383.1	12.3 10.4	12.5 10.3	14.0 12.5	13.5 10.0	NA	29 34	22	19 17	5	7	10 17	24 29	417 386	69.5 324.2	NA 254,700	#VALUE! 410	234	204 206	1908.4 1923.5	25.8 15.1	1.2 2.8	1.8 3.4	2.3 6.2	2.3 6.2
12	Wed	10/25/06	7:00 AM	1,421.3	1,393.6	11.1	10.5	10.0	8.0	567	33	19	19 21	5 5	14 4	14 6	28	381	583.9	259,700	401	241	209	1944.5	21.0	2.7	2.3	5.0	5.0
12	Thu Fri	10/26/06 10/27/06	6:43 AM 6:50 AM	1,432.3 1,440.7	1,404.7 1,413.5	11.0 8.4	11.1 8.8	13.5 11.5	12.0 12.0	781 849	27 30	23 24	18	5	6	12	22 25	420 409	850.8 1,077.2	266,900 226,400	403 439	244 246	212 214	1966.4 1981.0	21.9 14.6	0.0	0.6 2.4	0.0	0.0 5.2
	Sat	10/28/06	7:00 AM 9:20 AM	1,453.8 1.468.7	1,426.6 1.441.2	13.1 14.9	13.1 14.6	18.0 19.0	17.0 11.5	878 1647	30 37	22	18 28	5	8 NA	12 9	25 32	418 335	1,403.1 1.554.6	325,900	415 171	249	217 221	2006.8 2032.3	25.8 25.5	1.5	2.0	0.9	0.9
	Mon	10/29/06	6:48 AM	1,472.5	1,441.2	3.8	4.4	5.6	6.0	308	27	23	20	5	4	7	22	427	1,862.3	307,700	1,258	252 254		2032.3	10.9	0.0	1.1	0.0	0.0
	Tue	10/31/06	6:50 AM 7:02 AM	1,483.8 1.494.5	1,456.9 1,468.0	11.3	11.3 11.1	15.0 15.0	14.0 14.0	918 907	34 30	20	17 18	5 5	14 7	17 12	29	352 396	2,120.7 2.382.1	258,400 261,400	381 400	256 259	224 227	2064.5 2092.6	21.3 28.1	2.6 1.6	3.3	6.2 1.8	6.2 1.1
13	Thu	11/01/06	6:50 AM	1,503.2	1,478.8	10.7 8.7	10.8	16.0	14.5	948	32	23	18	5	12	14	25 27	379	2,645.3	263,200	455	261	230	2116.9	24.3	2.4	2.3	4.2	3.7
	Fri Sat	11/03/06	6:47 AM 7:00 AM	1,517.5 1,527.1	1,489.9 1,499.4	14.3 9.6	11.1 9.5	10.0 14.0	11.0 13.5	654 967	33 39	19	19 23	5 5	14 NA	14 16	28 34	389 286	2,907.9 3,140.6	262,600	350 406	263 265	233 236	2140.5 2159.5	23.6 19.0	2.6 0.0	2.0 1.3	5.1 0.0	5.0 3.9
	Sun	11/05/06	8:45 AM	1,539.1	1,511.7	12.0	12.3	16.0	16.5	NA	33	20	17	5	13	16	28	369	158.9	232,700 NA	#VALUE!	269	239	2186.7	27.2	2.5	3.1	3.7	3.7
	Mon Tue	11/06/06 11/07/06	6:54 AM 6:56 AM	1,550.3 1,562.0	1,523.1 1,534.6	11.2 11.7	11.4 11.5	15.5 16.5	14.5 15.0	898 951	33 36	20 19	17 16	5 5	13 17	16 20	28 31	375 342	432.1 703.0	273,200 270,900	403 389	272 275	242 245	2211.0 2242.5	24.3 31.5	1.8 2.3	2.4	4.8 6.0	4.8 6.0
	Wed	11/08/06	6:56 AM	1,572.6	1,545.5	10.6	10.9	17.0	16.0	1009	29	22	18	5	7	11	24	402	970.5	267,500	415	279	249	2277.8	35.3	0.8	0.0	0.0	0.0
14	Thu Fri	11/09/06	7:47 AM 7:05 AM	1,584.4 1.595.5	1,557.1 1.568.6	11.8	11.6 11.5	16.0 15.0	17.0 16.0	1014 963	33 27	19 24	19 20	5	14	14 7	28 22	381 437	1,236.8 1.500.0	266,300 263,200	379 388	282 286	252 256	2304.0 2339.8	26.2 35.8	2.4 0.0	2.4 0.6	4.4 0.0	5.3 0.0
	Sat	11/11/06	7:15 AM	1,606.1	1,578.5	10.6	9.9	15.0	15.5	993	30	21	20	5	9	10	25	415	1,751.1	251,100	409	289	259	2362.9	23.1	1.3	1.2	1.9	2.4
-	Sun	11/12/06 11/13/06	7:10 AM 7:10 AM	1,617.5 1,630.9	1,590.3 1,603.4	11.4 13.4	11.8 13.1	15.0 18.5	17.0 17.0	956 950	28 33	23 19	19 19	5	14	9 14	23 28	420 382	2,024.9 2,330.6	273,800 305,700	394 385	293 297	263 267	2397.3 2428.5	34.4 31.2	0.2 2.3	0.8 2.3	0.0 4.6	0.0 5.2
	Tue	11/14/06	7:00 AM	1,642.7	1,615.0	11.8	11.6	18.0	15.0	986	32	19	18 17	5	13	14 17	27	379	2,604.2	273,600	390	301	271	2461.7	33.2	2.8	2.8	3.2	3.7
15	Wed Thu	11/15/06	7:12 AM 6:47 AM	1,655.6 1,668.5	1,628.2 1,641.3	12.9 12.9	13.2 13.1	18.0 18.0	17.0 17.5	910 937	34 36	20	16	5 5	14 16	20	29 31	350 346	2,918.8 3,228.7	314,600 309,900	402 397	306 311	276 281	2575.7 2571.7	114.0 NA	1.3 1.5	2.3	0.7 2.5	0.7 2.5
	Fri Sat	11/17/06	6:54 AM 9:30 AM	1,681.6 1,696.8	1,654.2 1,670.3	13.1 15.2	12.9 16.1	18.0 20.0	17.0 19.0	NA 845	43 35	18 18	12 16	5	25 17	31 19	38 30	210 343	259.8 637.3	NA 377,500	#VALUE! 402	316 323	286 293	2623.7 2693.1	52.0 69.4	2.0 1.8	3.2 2.2	0.0	0.0
	Sun	11/19/06	10:00 AM	1,716.8	1,670.3	20.0	20.1	19.0	18.0	1197	30	18	21	5	12	9	25	398	890.1	252,800	210	329	300	2700.4	7.3	1.4	0.8	0.0	0.0
	Mon Tue	11/20/06	7:33 AM 6:53 AM	1,723.5 1,739.0	1,697.4 1,712.7	6.7 15.5	7.0 15.3	16.5 17.0	14.5 19.5	668 815	39	48	24	5	NA NA	15 NA	34 NA	400	1,269.5 1,636.0	379,400 366.500	924 397	333 340	305 312	2817.4	117.0	0.0	0.0	0.3	0.0
	Wed	11/21/06	7:16 AM	1,755.7	1,712.7	16.7	17.0	16.0	17.0	667	41	12	19	5	NA NA	22	36	240	2,040.9	404,900	401	346	318	2900.6 3020.2	119.6	0.0	0.0	1.5	0.0
16	Thu Fri	11/23/06 11/24/06	9:00 AM 8:45 AM	1,771.0 1,784.9	1,745.6 1,758.6	15.3 13.9	15.9 13.0	18.0 16.0	17.5 19.0	748 923	37 36	23	17 28	5 5	14 NA	20 8	32 31	413 337	2,429.0 2,739.3	388,100 310,300	415 385	354 359	326 332	3084.7 3123.0	64.5 38.3	0.2	0.9	0.0	0.0
	Sat	11/25/06	8:30 AM	1,797.3	1,771.4	12.4	12.8	17.0	14.5	826	35	16	19	5	19	16	30	361	3,051.2	311,900	413	365	338	3166.1	43.1	1.7	8.0	8.0	0.8
-	Sun	11/26/06	9:54 AM 7:01 AM	1,809.7 1,822.2	1,783.5 1,795.5	12.4	12.1 12.0	17.0 14.5	14.0 13.0	760	28 38	19 26	23	5	9	5	23 33	429 400	77.5 373.4	NA 295,900	#VALUE!	371 376	345 350	3211.9 3249.3	45.8 37.4	0.9 0.5	0.1	0.0	0.0
	Tue	11/28/06	6:51 AM	1,835.7	1,809.2	12.5 13.5	13.7	14.0	14.0	714	43	1	17	5	12 NA	26	38	215	694.0	320,600	393	381	356	8.2	NA	0.0	1.2	0.0	0.9
17	Wed	11/29/06	8:30 AM 7:03 AM	1,850.2 1,861.0	1,823.6 1,834.5	14.5 10.8	14.4	17.8 14.0	14.0	736 838	39 36	19 30	21	5	20 6	18 NA	34 31	416 348	1,047.0 1,286.2	353,000 239,200	407 367	388	362 364	55.8 88.0	47.6 32.2	1.9 0.0	1.2	0.0	0.0
	Fri	12/01/06	7:00 AM	1,876.0	1,848.5	15.0	14.0	15.0	16.0	733	45	13	54	5	32	NA	40	341	1,632.3	346,100	398	396	370	171.5	83.5	2.1	0.0	1.8	0.0
	Sat	12/02/06 12/03/06	7:15 AM 7:00 AM	1,888.5 1,900.5	1,861.0 1,874.5	12.5 12.0	12.5 13.5	14.0 15.0	15.0 17.0	NA NA	46 46	12 12	63 11	5 5	34 34	NA 35	41 41	345 322	NA 2,244.6	NA NA	#VALUE!	401 408	376 383	227.5 294.0	56.0 66.5	3.2 0.0	0.0	1.6 0.0	0.0
	Mon	12/04/06	8:10 AM	1,918.5	1,891.7	18.0	17.2	17.0	17.0	774	15	15	14	5	0	1	10	276	2,603.9	359,300	340	414	390	352.6	58.6	0.0	0.1	0.0	0.0
	Tue Wed	12/05/06	6:59 AM 11:30 AM	1,933.5 NR	1,906.3 NR	15.0 NA	14.6 NA	17.0 NR	15.0 NR	925 NA	43 NR	56 NR	16 NR	5 NR	-13 NA	27 NA	38 NA	400 NR	2,886.7 NR	282,800 NA	319 #VALUE!	418 NR	395 NR	388.3 NR	35.7 NA	0.0 NR	0.8 NR	0.0 NR	0.0 NR
18	Thu	12/07/06	7:00 AM	1,965.2	1,937.7	NA	NA	6.5	3.0	NA	27	22	0	5	5	27	22	272	146.6	NA	#VALUE!	431	407	463.1	NA	0.1	0.0	0.0	0.0
	Fri Sat	12/08/06 12/09/06	6:54 AM NR	1,982.0 NR	1,953.7 NR	16.8 NA	16.0 NA	off NR	off NR	NA NA	29 NR	23 NR	19 NR	5 NR	6 NA	10 NA	24 NA	335 NR	483.3 NR	336,700 NA	342 #VALUE!	436 NR	413 NR	492.7 NR	29.6 NA	0.6 NR	1.3 NR	0.0 NR	0.0 NR
	Sun	12/10/06	NR 7:00 AM	NR NR	NR NR	NA NA	NA	NR NR	NR	NA NA	NR NR	NR NR	NR	NR NR	NA	NA	NA	NR NR	NR NR	NA NA	#VALUE!	NR NR	NR	NR NR	NA NR	NR NR	NR NR	NR NR	NR NR
	Tue	12/11/06 12/12/06	7:00 AM 6:48 AM	NR NR	NR NR	NA NA	NA NA	NR NR	NR NR	NA NA	NR NR	NR NR	NR NR	NR NR	NA NA	NA NA	NA NA	NR NR	NR NR	NA NA	#VALUE!	NR NR	NR NR	NR NR	NR NR	NR NR	NR NR	NR NR	NR NR
1,0	Wed	12/13/06	7:03 AM	1,991.6	1,963.1	NA	NA	NR	NR	NA	35	20	20	5	15	15	30	355	687.3	NA	#VALUE!	437	414	499.6	NA	4.6	5.2	5.3	5.3
19	Thu Fri	12/14/06 12/15/06	9:10 AM 9:20 AM	2,002.0 2,012.4	1,973.7 1,984.4	10.4 10.4	10.6 10.7	10.0 17.0	12.0 11.0	776 947	37 36	18 20	19 21	17/20 20/22	19 16	18 15	NA NA	326 330	919.2 1,161.1	231,900 241,900	368 382	437 438	414 415	499.6 509.2	9.6	15.0 9.2	15.8 8.4	17.0 12.1	17.0 12.0
	Sat	12/16/06	NA NA	2,023.4	1,994.8	11.0 11.0	10.4 11.8	7.0 6.0	12.0	579 553	34 31	20 26	19 19	20/20	14 5	15 12	NA NA	358 429	1,429.5 1,666.3	268,400 236,800	418 347	439 440	416	517.4 525.3	8.2 7.9	8.1 2.4	8.5 4.0	12.6	12.6 10.3
	oun	12/11/06	INA	2,034.4	2,000.0	11.0	11.0	0.0	10.0	553	31	20	19	20/20	J	12	INA	429	1,000.3	230,000	347	440	41/	525.3	7.9	2.4	4.0	5.5	10.3

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet (Continued)

	Ι																												
									KMnO₄							Pressure F	iltration							1	Baci	wash	Since L	ast BW	
								KMnO <sub>4</sub>	Tank 2	Estimated											Daily					Run			Standby
Week	Davo	, f		Tank A Hour	r Tank B Hour Meter	TA Run Time	TB Run Time	Tank 1 Level <sup>(a)</sup>	Level (Iron)	KMnO₄ Dosage	Influent	Outlet Tank A	Outlet Tank B	Effluent	Inlet-TA	Inlet-TB	Inlet- Effluent	Flow	Totalizer to Distribution	Gallon Usage	Average Flowrate	Tank A	Tank	Total Volume	Daily Volume	Time Tank A	Time Tank B	Time Tank A	Time Tank B
No.	Weel		Time	hrs	hrs	hrs	hrs	inches		μg/L as Mn	psig	psig	psig	psig	psig	psig	psig	gpm	kgal	gal	gpm	No.	No.	kgal	kgal	hrs	hrs	hrs	hrs
	Mon Tue			2,045.1	2,016.3 2,027.3	10.7 10.7	9.7	6.0	9.0	517 505	34 40	17 20	23	17/25 20/0	17 20	11 40	NA NA	362	1,903.4 2.146.5	237,100 243,100	388 373	440 441	418 419	528.9 536.4	3.6 7.5	13.1 10.7	5.8 10.4	15.2	8.1
	Wed	12/20/06	7:00 AM	2,067.3	2,039.3	11.5	12.0	7.0	11.0	567	34	22	17	22/17	12	17	NA	363	2,406.1	259,600	368	442	420	546.5	10.1	5.8	12.0	5.4	10.7
20	Thu	12/21/06		2,077.9 2,092.4	2,049.8 2,064.1	10.6 14.5	10.5 14.3	6.0 7.0	11.0 13.0	563 529	9 34	12 24	10 17	11/11 28/17	NA 10	NA 17	NA NA	364	2,653.2 2,962.4	247,100 309,200	390 358	443 444	421 421	557.5 569.5	11.0 12.0	3.1 4.1	10.0 12.3	5.6 3.7	11.3 12.9
	Sat	12/23/06	7:05 AM	2,099.0	2,070.3	6.6	6.2	7.0	8.0	853	35	19	21	17/16	16	14 17	NA	336	3,106.2	143,800	375	444	423	574.5	5.0	10.6	5.6	14.0	4.9
-	Sun			2,112.6 2,127.7	2,084.3 2,098.6	13.6 15.1	14.0 14.3	7.0 8.0	10.0 12.0	NA 514	34 10	24	17 10	25/18 11/12	10 NA	NA	NA NA	360	129.2 447.2	NA 318,000	#VALUE! 361	446 447	424 426	595.3 611.3	20.8 16.0	2.1 7.9	8.2 3.1	4.8 8.4	9.9 0.8
	Tue	12/26/06	8:30 AM	2,137.4	2,108.3	9.7	9.7	4.5	8.0	489	34	16	12	17/22	18	22	NA	335	656.1	208,900	359	448	427	622.9	11.6	8.0	3.4	8.2	4.3
21	Wed Thu			2,148.2 2,159.9	2,119.2 2,130.8	10.8 11.7	10.9 11.6	7.0 6.0	9.0	546 514	34 33	23 18	17 21	25/19 19/23	11 15	17 12	NA NA	355 371	895.7 1,150.2	239,600 254,500	368 364	450 451	428 430	640.5 656.8	17.6 16.3	2.4 5.6	7.2 2.5	5.4 7.7	8.2 5.7
	Fri Sat	12/29/06		2,171.3 2,184.6	2,143.1 2.156.6	11.4 13.3	12.3 13.5	6.0 6.5	10.0 11.0	499 476	34 40	16 36	16 31	23/19 30/30	18 4	18 9	NA NA	378	1,412.6 1,713.1	262,400 300.500	370 374	453 455	431 433	676.5 699.8	19.7	2.1 1.0	6.8 5.4	5.0 0.0	6.8 7.8
	Sun	12/31/06	2:10 AM	2,198.5	2,170.7	13.9	14.1	10.0	11.0	551	33	24	17	24/17	9	16	NA	365	2,024.9	311,800	371	457	435	719.9	23.3 20.1	2.1	5.9	0.7	5.2
	Mon Tue		1:00 AM 7:40 AM	2,210.1 2,217.8	2,181.1 2,188.8	11.6 7.7	10.4 7.7	6.0 5.0	8.0 6.5	480 527	12 32	11 20	10 24	11/11 21/27	NA 12	NA 8	NA NA	401	2,263.5 2,442.1	238,600 178,600	363 387	458 459	437 438	732.6 742.5	12.7 9.9	4.9 4.7	1.2	5.3 7.3	0.5 2.7
	Wed	01/03/07	6:56 AM	2,228.9	2,201.1	11.1	12.3	6.5	9.0	491	33	25	17	21/19	8	16	NA	378	2,700.4	258,300	369	461	439	756.8	14.3	1.5	5.9	5.3	7.8
22	Thu	01/04/07		2,241.2 2.251.9	2,212.6 2,222.7	12.3 10.7	11.5 10.1	6.0 6.0	9.0	472 519	9 36	11 18	12 20	10/11 16/21	NA 18	NA 16	NA NA	340	2,960.5 3.197.1	260,100 236,600	365 379	462 463	441 442	771.2 781.5	14.4 10.3	5.0 7.9	1.1 4.0	5.7 9.0	1.9 6.5
	Sat	01/06/07	10:00 AM	2,264.6	2,235.1	12.7	12.4	6.0	9.0	NA	31	19	24	18/25	12	7	NA	380	206.8	NA	#VALUE!	465	444	802.5	21.0	4.1	1.1	6.1	0.0
-	Sun		8:10 AM 6:51 AM	2,275.0 2,286.5	2,245.4 NR	10.4 11.5	10.3 NA	5.0 9.0	8.0 10.0	457 587	34 9	18	20 10	17/21 11/11	16 NA	14 NA	NA NA	366	439.4 704.3	232,600 264,900	375 #VALUE!	466 468	445 447	811.6 830.2	9.1 18.6	6.7 2.4	4.1 0.9	7.7 5.3	6.7 0.3
	Tue	01/09/07	8:00 AM	2,298.7	2,270.9	12.2	NA 10.7	9.0	10.0	539 591	33	25 17	15 23	10/13.5	8 15	18	NA NA	352.7 394.8	992.8 1.242.1	288,500	#VALUE!	470 471	448 450	845.0	14.8 14.3	1.2 5.3	5.3	0.0	5.7
23	Wed Thu		7:03 AM 6:50 AM	2,309.5 2,319.0	2,281.6 2,291.8	10.8 9.5	10.7 10.2	8.0	9.0	591	32 32	26	17	17/25 27/22	6	9 15	NA NA	401.5	1,242.1	249,300 235,200	387	473	450	859.3 874.6	15.3	0.0	4.7	4.6 0.0	6.6
	Fri	01/12/07		2,331.0 2.341.3	2,303.2 2.314.0	12.0 10.3	11.4 10.8	9.0 9.0	9.0	549 645	33	17	22 17	23/18 12/21	16 6	11 15	NA NA	389.8	1,745.5 1,986.3	268,200 240,800	382 381	474 476	453 454	889.3 903.3	14.7 14.0	5.0 0.1	1.8 5.8	6.3	5.3 7.2
	Sun	0 17 10/07	7:25 AM	2,352.6	2,324.5	11.3	10.5	9.0	9.0	547	32 33	26 19	22	23/19	14	11	NA	414.9	2,255.5	269,200	412	477	456	917.8	14.5	4.7	1.9	8.8	7.1
	Mon Tue		6:59 AM	2,364.9	2,336.8 2,348.4	12.3	12.3 11.6	9.0 7.0	9.0 9.0	528 488	34 34	23 18	16 19	23/16 19/21	11 16	18 15	NA NA	380 385	2,534.3 2,802.6	278,800 268,300	378 384	479 480	457 459	930.5 943.9	12.7 13.4	2.1 6.2	6.8 3.9	6.1	9.1 5.6
	Wed	01/17/07	7:00 AM	2,387.1	2,359.4	10.5	11.0	6.0	8.0	445	39	24	0	25/2	15	39	NA	303	3,060.1	257,500	399	482	460	958.4	14.5	2.9	0.0	5.2	0.0
24	Thu	01/18/07	7:02 AM	2,398.6 2,410.4	2,370.9 2.382.4	11.5 11.8	11.5 11.5	6.0 7.0	8.0 9.0	NA 474	9 41	11 58	10 19	11/12 0/21	NA NA	NA NA	NA NA	218	57.8 334.0	NA 276,200	#VALUE!	484 485	462 464	978.3 995.3	19.9 17.0	1.6 0.0	5.4 4.1	1.3 0.0	5.7 5.3
	Sat	01/20/07	8:00 AM	2,430.5	2,402.1	20.1	19.7	12.0	13.0	442	35	16	18	20	19	17	NA	392	796.6	462,600	387	488	467	1020.4	25.1	5.0	2.2	1.7	0.4
-	Sun		7:00 AM 7:07 AM	2,438.6 2,447.9	2,409.8 2,419.7	8.1 9.3	7.7 9.9	6.0 5.0	7.0 7.0	575 448	35 34	17 22	20 15	22 23/17	18 12	15 19	NA NA	307 365	981.5 1,200.7	184,900 219,200	390 381	489 491	468 469	1029.1 1041.3	8.7 12.2	6.2 1.8	3.3 6.5	6.0 3.1	0.6 6.5
	Tue	01/23/07	7:25 AM	2,460.6	2,431.5	12.7	11.8	8.0	7.0	436	35	16	19	23	19	16	NA	353	1,482.3	281,600	384	492	471	1055.0	13.7	7.6	4.0	5.7	5.1
25	Wed			2,471.0 2,484.1	2,442.3 2,455.2	10.4 13.1	10.8 12.9	16.0 9.0	17.0 9.0	1072 495	34 32	21 25	16 16	22 18/25	13 7	18 16	NA NA	360 410	1,734.1 2,031.7	251,800 297,600	396 382	494 496	472 474	1069.0 1091.3	14.0 22.3	2.6 0.5	6.4 4.7	4.9 0.0	6.6 5.2
	Fri	01/26/07	7:02 AM	2,497.2	2,468.4	13.1	13.2	9.0	9.0	499	33	17	21	18/23	16	12	NA	384	2,326.9	295,200	374	497	476 477	1106.4	15.1	5.5	2.1	5.2 4.7	3.4
	Sat Sun	01/27/07	7:50 AM 8:30 AM	2,509.4 2,522.9	2,481.0 2,494.1	12.2 13.5	12.6 13.1	9.0 9.0	9.0	515 482	40 29	23 18	NR 11	24/3 19/12	17 11	NA 18	NA NA	280 450	2,612.8 2,918.1	285,900 305,300	384 383	499 501	477	1121.8 1144.0	15.4 22.2	3.1 1.7	0.0 5.5	1.6	7.2
	Mon Tue		7:00 AM 6:57 AM	2,537.0 2,550.9	2,508.3 2,521.7	14.1 13.9	14.2 13.4	9.0	9.0	450 NA	33 35	24 17	16 19	18/25 1720	9 18	17 16	NA NA	375 375	3,244.9 273.1	326,800 NA	385 #VALUE!	503 504	481 483	1164.2 1181.9	20.2 17.7	0.8 6.5	5.9 3.8	0.0 4.8	5.6 4.8
	Wed	01/21/07	7:18 AM	2,565.6	2,536.3	14.7	14.6	9.0	9.0	467	33	16	20	19/23	17	13	NA	400	588.3	315,200	359	506	485	1202.4	20.5	5.9	2.3	5.3	4.0
26	Thu Fri	02/01/07	7:00 AM 7:02 AM	2,579.3 2.595.6	2,550.0 2.566.4	13.7 16.3	13.7 16.4	9.0 13.0	9.0	471 537	33 36	17 17	22 20	17/24 10	16 19	11 16	NA NA	370 375	901.0 1.266.4	312,700 365,400	380 372	508 510	487 489	1221.3 1241.0	18.9 19.7	5.6 7.2	1.7 3.3	4.0 3.7	0.9 3.7
	Sat	02/03/07	7:15 AM	2,615.2	2,585.9	19.6	19.5	12.0	17.0	541	33	19	22	24/19	14	11	NA	420	1,705.1	438,700	374	513	492	1282.1	41.1	5.0	1.7	2.1	2.1
-	Sun		7:00 AM 6:57 AM	2,631.9 2,649.7	2,602.4 2,621.2	16.7 17.8	16.5 18.8	9.0 17.0	12.0 12.0	467 569	35 32	19 20	20 21	22/19	16 12	15 11	NA NA	385 412	2,073.2 2,489.7	368,100 416,500	370 380	515 518	494 497	1318.7 1373.2	36.6 54.5	6.3 3.0	3.0 2.0	5.0 2.3	4.9 1.8
	Tue	02/06/07	7:05 AM	2,664.1	2,636.1	14.4	14.9	5.0	9.0	350	33	18	22	18/24	15	11	NA	400	2,817.2	327,500	373	520	499	1403.6	30.4	4.0	1.7	5.3	0.9
27	Wed		7:05 AM 7:21 AM	2,678.8 2,692.2	2,650.1 2,665.3	14.7 13.4	14.0 15.2	0.0	7.0 9.0	181 NA	35 32	17 24	20 16	18/21 25/18	18 8	15 16	NA NA	377 383	3,134.3 192.4	317,100 NA	369 #VALUE!	522 525	501 503	1442.9 1495.6	39.3 52.7	5.1 1.0	2.6 5.0	4.8 0.0	4.9 4.5
	Fri Sat	02/09/07		2,706.3 2,716.7	2,679.0 2,690.1	14.1 10.4	13.7 11.1	7.0 8.0	9.0 13.0	427 686	33 41	19	22 21	20/24 NA	14 NA	11 20	NA NA	405	498.9 749.3	306,500 250,400	368 389	526 527	505 506	1517.1 1528.6	21.5 11.5	6.5 NR	2.1 4.2	5.3 0.0	2.4 6.3
	Sun			2,716.7	2,704.9	15.1	11.1	10.0	20.0	733	33	17	20	NA NA	16	13	NA NA	380	1,084.0	334,700	373	527	508	1528.6	19.9	5.4	2.3	6.0	0.9
	Mon Tue			2,751.4 2,770.9	2,725.2 2,744.3	19.6 19.5	20.3	2.0	2.0	128 204	38 35	21 16	15 17	27/12 18/12	17 19	23 18	NA NA	328 163	1,338.9 1,499.2	254,900 160,300	213 138	530 530	508 509	1554.5 1557.8	6.0 3.3	3.2 22.6	22.5 17.6	0 2.6	1.1
	Wed			2,770.9	2,764.5	20.5	20.2	0.0	0.0	0	33	14	18	15/20	19	15	NA NA	267	1,817.0	317,800	260	531	511	1568.7	10.9	19.2	6.9	2.4	25 2.1
28	Thu Fri	02/15/07	7:00 AM 7:00 AM	2,814.1 2.834.7	2,786.7 2,807.1	22.7 20.6	22.2 20.4	0.0	0.0	0	32 30	14 15	17 16	15/20 15/19	18 15	15 14	NA NA	269 283	2,167.9 2,489.7	350,900 321,800	261 262	532 533	512 514	1599.7 1601.7	31.0 2.0	22.6 19.9	6.9 8.6	0.5 2.5	0.0 1.4
	Sat	02/17/07	8:20 AM	2,851.3	2,823.8	16.6	16.7	0.0	0.0	0	26	15	18	15/20	11	8	NA	294	2,772.5	282,800	283	534	515	1616.9	15.2	12.7	8.3	3.3	3.3
-	Sun		9:00 AM 7:00 AM	2,869.8 2.887.7	2,842.1 2.860.7	18.5 NA	18.3 NA	0.0	0.0	0 NA	24 32	16 17	19 14	16/21 18/15	8 15	5 18	NA NA	325 268	3,076.3 101.3	303,800 NA	275 #VALUE!	535 536	516 516	1633.5 1640.8	16.6 NA	11.2 8.0	0.1 18.7	5.1 3.1	0.0 3.1
	Tue	02/20/07	11:45 AM	2,911.4	2,884.9	23.7	24.2	0.0	0.0	0	28	19	14	14	9	14	NA	294	520.4	419,100	292	538	518	1662.6	21.8	3.4	11.4	0.0	2.4
29	Wed		7:15 AM 6:50 AM	2,929.1 NR	2,902.7 NR	17.7 NR	17.8 NR	0.0	0.0	0	24 NR	16 NR	8 NR	8 NR	8 NR	16 NR	NA NA	322 NR	815.5 865.3	295,100 49,800	277 #VALUE!	539 NR	519 NR	1674.3 NR	11.7 NA	2.6 NR	13.3 NR	0.0 NR	1.3 NR
1 23	Fri	02/23/07	6:58 AM	2,963.6	2,937.0	NA	NA	0.0	0.0	0	28	14	19	15/21	14	9	NA	292	1,151.2	285,900	#VALUE!	540	521	1684.5	NA	13.1	2.7	6.7	4.7
	Sat			2,977.7 2.995.1	2,951.5 2.968.3	14.1 17.4	14.5 16.8	0.0	0.0	0	30 23	16 15	14 19	15/15 15/20	14 8	16 4	NA NA	278 310	1,386.2 1.678.0	235,000 291.800	274 284	541 542	521 523	1689.1 1702.7	4.6 13.6	9.2 9.2	17.2 0.3	7.2 7.6	14.0 0.0
	Mon	02/26/07	6:49 AM	3,011.0	2,985.0	15.9	16.7	0.0	0.0	0	30	18	13	14/17	12	17	NA	272	1,925.8	247,800	254	543		1714.5	11.8	6.2	15.6	4.6	5.4
	Tue Wed	02/27/07	6:56 AM 7:18 AM	3,022.3 3,037.5	2,996.2 3,011.6	11.3 15.2	11.2 15.4	0.0	0.0	0	31 32	15 17	15 13	15/15 17/14	16 15	16 19	NA NA	265 269	2,154.4 2,409.9	228,600 255,500	339 278	544 545	524 525	1714.5 1722.9	0.0 8.4	11.6 7.6	12.3 14.4	10.2 4.3	10.1 7.9
30	Thu	03/01/07		3,051.3	3,025.4	13.8	13.8	0.0	0.0	0	25 27	15 15	19 17	15/20	10	6	NA	309 287	2,655.4	245,500	296	546 547	527	1734.4 1741.6	11.5 7.2	8.3	1.9 5.0	5.3	0.8 4.7
	Fri Sat			3,065.6 3,077.3	3,039.3 3,050.8	14.3 11.7	13.9 11.5	0.0	0.0 2.0	0 78	26	16	17	15/19 16/19	12 10	10 9	NA NA	315	2,901.4 3,110.7	246,000 209,300	291 301	548	528 529	1748.5	6.9	9.5 9.7	5.0 4.4	4.9 10.2	6.8
	Sun			3,092.6	3,066.8	15.3	16.0	0.0	3.0	NA	25	19	15	20/15	6	10	NA	305	110.8	NA	#VALUE!	550	530	1759.0	10.5	2.7	4.5	6.0	6.9

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet (Continued)

																						I							
									KMnO₄				1			Pressure F	iltration								Bac	kwash	Since I	Last BW	
								KMnO <sub>4</sub>	Tank 2	Estimated											Daily					Run	Run	Standby	Standby
Week	Day of			Tank A Hour Meter	Tank B Hour Meter	TA Run Time	TB Run Time	Tank 1 Level <sup>(a)</sup>	Level (Iron)	KMnO₄ Dosage	Influent	Outlet Tank A	Outlet Tank B	Effluent	Inlet-TA	Inlet-TB	Inlet- Effluent	Flow	Totalizer to Distribution	Gallon Usage	Average Flowrate	Tank A	Tank B	Total Volume	Daily Volume	Time Tank A	Time Tank B	Time Tank A	Time Tank B
No.	Week	Date 03/05/07	Time 7:00 AM	hrs 3,108.1	hrs 3,081.8	hrs 15.5	hrs 15.0	inches NR	inches NR	μg/L as Mn NA	psig 23	psig 16	psig 20	psig 15	psig	psig	psig 8	gpm 321	kgal 385.8	gal 275.000	<b>gpm</b> 301	No. 551	No. 532	kgal 1769.5	kgal 10.5	hrs 7.3	hrs 0.2	hrs 5.5	hrs 0.0
	Tue	03/06/07	6:59 AM	3,122.6	3,095.8	14.5	14.0	NR	NR	NA	26	16	18	15	10	8	11	297	632.6	246,800	289	552	533	1776.8	7.3	9.9	3.7	8.5	5.9
31	Wed Thu	03/07/07	6:59 AM 7:00 AM	3,163.3 3,150.3	3,110.1 3,124.1	NA NA	14.3 14.0	NR NR	NR NR	NA NA	23 26	21 19	15 15	15 15	7	8 11	8 11	300 301	880.5 1,129.1	247,900 248,600	#VALUE!	554 555	534 535	1787.3 1794.1	10.5 6.8	0.1 3.8	7.5 9.3	0.0 5.5	4.9 6.5
	Fri Sat	03/09/07	8:00 AM 9:15 AM	3,167.6 3.183.3	3,141.0 3,157.2	17.3 15.7	16.9 16.2	NR NR	NR NR	NA NA	21 26	15 22	17 13	14 15	6	13	7	280 301	1,355.7 1,646.7	226,600 291,000	221 304	556 558	537 538	1804.2 1814.9	10.1 10.7	10.4 0.8	5.6 10.8	3.5 0.0	3.5 7.5
	Sun	03/11/07	9:15 AM	3,200.3	3,174.4	17.0	17.2	NR	NR	NA	30	19	13	14	11	17	16	255	1,926.1	279,400	272	559	539	1822.8	7.9	4.8	13.1	6.0	6.0
	Mon Tue	03/12/07 03/13/07	7:00 AM 7:00 AM	3,216.0 3,230.9	3,190.4 3,204.9	15.7 14.9	16.0 14.5	NR NR	NR NR	NA NA	32 32	17 17	13 13	14 14	15 15	19 19	18 18	265 251	2,181.7 2,420.0	255,600 238,300	269 270	560 561	540 541	1830.8 1838.7	8.0 7.9	7.2 6.9	14.8 14.3	3.9 4.9	3.9 8.3
32	Wed Thu	03/14/07	7:22 AM 7:01 AM	3,246.0 3,259.4	3,220.1 3,233.5	15.1 13.4	15.2 13.4	NR NR	NR NR	NA NA	31 31	18 19	13 14	14 14	13 12	18 17	17 17	263 275	2,668.1 2,893.0	248,100 224,900	273 280	562 563	542 543	1847.1 1856.7	8.4 9.6	7.3 5.0	15.2 12.9	4.4 5.2	7.9 8.9
	Fri	03/16/07	7:00 AM	3,275.1	3,249.3	15.7	15.8	NR	NR	NA	30	18	14	14	12	16	16	275	3,149.3	256,300	271	564	544	1865.8	9.1	5.5	13.8	4.0	7.2
	Sat Sun	03/17/07	7:40 AM NR	3,290.3 3,308.8	3,264.3 3,282.4	15.2 18.5	15.0 18.1	NR NR	NR NR	NA NA	31 28	18 15	20	18 15	13 13	17 8	13 13	252 297	124.7 428.5	NA 303,800	#VALUE! 277	565 566	545 547	1875.5 1890.5	9.7 15.0	6.4 9.8	13.9 3.1	5.2 4.2	8.4 4.1
	Mon Tue	03/19/07	7:00 AM 7:00 AM	3,328.4 3,343.1	3,302.4 3,317.0	19.6 14.7	20.0 14.6	NR NR	NR NR	NA NA	29 29	20 19	13 14	14 15	9 10	16 15	15 14	270 280	746.8 994.8	318,300 248,000	268 282	568 569	548 549	1903.9 1913.0	13.4 9.1	3.8 4.9	11.5 4.1	1.5 12.6	1.5 7.2
33	Wed	03/21/07	7:00 AM	3,358.3	3,332.3	15.2	15.3	NR	NR	NA	32	19	14	15	13	18	17	268	1,252.0	257,200	281	570	550	1922.1	9.1	6.0	13.7	4.1	7.6
33	Thu Fri	03/22/07	7:00 AM 7:05 AM	3,373.1 3,388.3	3,346.9 3,362.1	14.8 15.2	14.6 15.2	NR NR	NR NR	NA NA	30 35	19 19	14 0	15 11	11 16	16 35	15 24	275 235	1,498.7 1,752.7	246,700 254,000	280 279	571 572	551 552	1931.2 1940.8	9.1 9.6	6.6 7.2	19.2 0.0	5.8 4.3	8.1 0.0
	Sat Sun	03/24/07	10:00 AM 10:20 AM	3,407.3 3.424.4	3,381.3 3.398.2	19.0 17.1	19.2 16.9	NR NR	NR NR	NA NA	30	15 15	19 17	15 15	15 18	11 16	15 18	280 250	2,075.1 2.355.3	322,400 280,200	281 275	573 574	554 555	1955.2 1964.9	14.4 9.7	11.1 14.1	4.8 7.6	4.6 5.9	2.5 5.9
	Mon	03/26/07	7:05 AM	3,442.0	3,416.5	17.6	18.3	NR	NR	NA	29	21	13	15	8	16	14	280	2,651.8	296,500	275	576	556	1981.2	16.3	3.0	11.4	1.8	1.8
	Tue Wed	03/27/07 03/28/07	6:55 AM 7:05 AM	3,457.7 3,475.2	3,432.2 3,449.4	15.7 17.5	15.7 17.2	NR NR	NR NR	NA NA	26 29	15 15	22 19	15 15	11 14	4 10	11 14	310 295	2,924.6 3,206.1	272,800 281,500	290 270	577 578	558 559	1993.4 2005.0	12.2 11.6	10.6 11.0	0.7 4.4	4.0 4.1	0.0 4.0
34	Thu Fri	03/29/07	7:05 AM 7:21 AM	3,492.3 3,509.9	3,466.6 3,484.3	17.1 17.6	17.2 17.7	NR NR	NR NR	NA NA	29 31	16 15	18 18	15 14	13 16	11 13	14 17	285 275	211.2 501.5	NA 290,300	#VALUE! 274	579 580	560 561	2017.8 2030.1	12.8 12.3	12.3 14.4	5.8 7.8	3.6 4.2	5.8 2.9
	Sat	03/31/07	9:00 AM	3,529.1	3,505.0	19.2	20.7	NR	NR	NA	29	22	14	15	7	15	14	292	836.5	335,000	280	582	562	2049.1	19.0	3.7	12.6	3.9	4.0
<b>-</b>	Sun	04/01/07	9:20 AM 7:00 AM	3,547.6 3,567.8	3,522.0 3,542.0	18.5 20.2	17.0 20.0	NR NR	NR NR	NA NA	32 24	20 16	14 21	15 15	8	18 3	17 9	270 305	1,135.7 1,423.9	299,200 288,200	281 239	583 584	563 566	2061.0 2085.0	11.9 24.0	6.6 84.0	15.2 0.9	5.4 0.0	5.4 0.0
	Tue Wed	04/03/07 04/04/07	7:00 AM 7:00 AM	3,586.8 3,603.5	3,561.1 3,578.2	19.0 16.7	19.1 17.1	NR NR	NR NR	NA NA	24 29	21 19	15 15	15 15	3 10	9 14	9 14	285 269	1,745.7 2,028.2	321,800 282,500	282 279	586 587	567 568	2102.2 2110.9	17.2 8.7	2.4 6.2	8.5 13.4	3.3	3.8 4.8
35	Thu	04/05/07	6:55 AM	3,620.1	3,594.5	16.6	16.3	NR	NR	NA	27	22	14	15	5	13	12	295	2,311.2	283,000	287	589	570	2127.8	16.9	1.6	7.2	0.3	3.0
	Fri Sat	04/06/07	7:30 AM 7:45 AM	3,634.6 3,650.6	3,608.6 3,625.1	14.5 16.0	14.1 16.5	NR NR	NR NR	NA NA	26 27	17 21	20 15	15 15	9	6 12	11	298 289	2,564.1 2,843.5	252,900 279,400	295 287	590 592	572 573	2138.9 2149.2	11.1	6.6 2.0	2.1 8.3	5.1 3.2	3.0 6.0
-	Sun Mon	04/08/07 04/09/07	7:15 AM 7:00 AM	3,666.7 3,683.2	3,640.4 3,656.9	16.1 16.5	15.3 16.5	NR NR	NR NR	NA NA	27 24	16 17	19 21	15 16	11	8	12 8	294 314	3,109.6 111.7	266,100 NA	283 #VALUE!	593 595	575 577	2159.1 2172.4	9.9 13.3	8.0 5.4	3.4 0.1	5.9 4.1	5.9 0.0
	Tue	04/10/07	7:15 AM	3,697.8	3,671.6	14.6	14.7	NR	NR	NA	29	17	18	15	12	11	14	290	365.6	253,900	289	596	578	2179.3	6.9	9.7	5.5	6.0	5.2
36	Wed Thu	04/11/07	7:20 AM 7:03 AM	3,713.0 3,728.8	3,687.1 3,702.9	15.2 15.8	15.5 15.8	NR NR	NR NR	NA NA	36 48	21 62	10	14 11	15 NA	NA 38	22 37	215	627.4 892.9	261,800 265,500	284 280	598 599	581	2191.8 2208.4	12.5 16.6	5.1 0.0	5.3 5.9	0.0	0.0 4.4
	Fri Sat	04/13/07	NA 10:00 AM	3,744.7 3.754.3	3,718.0 3,733.2	15.9	15.1 15.2	NR NR	NR NR	NA NA	26 29	16 17	21 18	15 15	10 12	5 11	11 14	308 297	1,162.1 1.471.4	269,200 309,300	290 438	601 602	583 585	2220.5 2237.8	12.1 17.3	7.2 5.3	1.3	3.6 1.1	1.5 0.0
	Sun	04/15/07	9:30 AM	3,776.6	3,748.9	22.3	15.7	NR	NR	NA	28	15	19	15	13	9	13	277	1,698.0	226,600	205	604	587	2248.8	11.0	9.6	4.1	6.3	6.3
	Mon Tue	04/16/07 04/17/07	7:00 AM 7:00 AM	3,791.5 3,809.9	3,764.4 3,781.9	14.9 18.4	15.5 17.5	NR NR	NR NR	NA NA	28 29	19 16	15 18	15 15	9 13	13 11	13 14	268 267	1,953.5 2,205.6	255,500 252,100	280 234	606 607	588 590	2260.9 2273.6	12.1 12.7	4.0 11.9	10.3 4.6	3.9 1.1	4.6 1.0
37	Wed Thu	04/18/07	7:15 AM 7:00 AM	3,825.3 3,840.0	3,797.7 3,812.7	15.4 14.7	15.8 15.0	NR NR	NR NR	NA NA	23 23	17 16	21 18	15 15	6 7	<u>2</u> 5	8	305 270	2,473.9 2,724.5	268,300 250,600	287 281	609 610	592 593	2290.3 2299.1	16.7 8.8	5.3 9.7	0.1 5.1	4.3 4.0	0.0 4.0
-	Fri	04/20/07	7:00 AM	3,853.5	3,827.4	13.5	14.7	NR NR	NR NR	NA NA	41	35	32	30	6	9	11	170	2,968.3	243,800	289	612 614	594	2312.2	13.1	3.7	9.4	4.7	5.5
	Sat Sun	04/21/07 04/22/07	9:00 AM 8:00 AM	3,871.1 3,887.3	3,844.3 3,859.9	17.6 16.2	16.9 15.6	NR	NR	NA	25 26	22 17	15 19	15 15	9	10 7	10 11	297 NR	3,266.5 260.3	298,200 NA	288 #VALUE!	615	596 598	2328.0 2340.0	15.8 12.0	0.9 7.6	6.5 3.1	0.0 5.9	4.7 6.0
	Mon Tue	04/23/07 04/24/07	7:00 AM 7:00 AM	3,907.1 3,922.9	3,879.8 3,896.4	19.8 15.8	19.9 16.6	NR NR	NR NR	NA NA	29 29	16 19	19 15	15 15	13 10	10 14	14 14	280 280	597.6 871.8	337,300 274,200	283 282	617 619	600 601	2355.4 2367.2	15.4 11.8	8.3 4.5	4.2 9.8	1.7 3.6	1.7 3.6
38	Wed	04/25/07	7:05 AM	3,938.3	3,911.0	15.4	14.6	NR	NR	NA	38	62 17	20	14	NA	18	24	380	1,131.7	259,900	289	620	603	2382.7	15.5	0.0	5.8	0.0	5.1
38	Thu Fri	04/26/07 04/27/07	7:02 AM 7:00 AM	3,954.2 3,969.4	3,926.8 3,942.7	15.9 15.2	15.8 15.9	NR NR	NR NR	NA NA	27 27	20	20 16	15 15	10 7	11	12 12	300 290	1,403.7 1,666.2	272,000 262,500	286 281	622 624	605 606	2394.3 2406.8	11.6 12.5	6.3 2.6	2.9 8.3	3.7	4.5 3.7
	Sat Sun	04/28/07	7:05 AM 7:05 AM	3,982.6 3.999.9	3,955.5 3,972.0	13.2 17.3	12.8 16.5	NR NR	NR NR	NA NA	25 24	17 17	21 19	15 15	8 7	4 5	10 9	304 305	1,891.9 2.192.1	225,700 300,200	289 296	624 627	608 610	2418.1 2434.1	11.3 16.0	6.0 5.8	7.1 2.3	6.1 5.0	2.8 5.0
	Mon Tue	04/30/07	7:00 AM 7:10 AM	4,018.6 4.036.1	3,991.6	18.7 17.5	19.6	NR NR	NR NR	NA	24	16	18 15	15 15	8	6	9	294 285	2,515.1	323,000	281	628 630	611 612	2446.4	12.3	13.1	7.4	4.2	4.2
	Wed	05/01/07 05/02/07	7:00 AM	4,052.5	4,009.8 4,027.0	16.4	18.2 17.2	NR	NR	NA NA	26 23	21 20	17	15	3	6	8	291	2,814.5 3,089.0	299,400 274,500	280 272	631	613	2469.3 2481.8	22.9 12.5	2.7 2.5	12.5	2.2	3.3
39	Thu Fri	05/03/07	7:00 AM 7:00 AM	4,068.5 4.084.4	4,043.0 4,059.1	16.0 15.9	16.0 16.1	NR NR	NR NR	NA NA	19 18	14 12	10 11	15 15	5 6	9 7	3	320 290	78.0 349.6	NA 271,600	#VALUE! 283	632	614 615	2498.0 2508.2	16.2 10.2	3.3 4.8	9.5 12.1	3.1 4.8	3.0 6.9
	Sat Sun	05/05/07 05/06/07	7:10 AM 6:50 AM	4,099.8 4,117.4	4,074.4 4.090.9	15.4 17.6	15.3 16.5	NR NR	NR NR	NA NA	27 24	22 18	15 20	15 15	5	12 4	12 9	280 295	603.2 880.7	253,600 277,500	275 272	634 635	616 618	2518.6 2532.5	10.4 13.9	4.0 7.7	13.3 2.3	5.2 4.5	7.3 4.4
	Mon	05/07/07	6:55 AM	4,135.2	4,110.1	17.8	19.2	NR	NR	NA	28	20	16	15	8	12	13	286	1,184.5	303,800	274	637	619	2544.6	12.1	4.8	11.1	3.3	3.3
	Tue Wed	05/08/07	7:00 AM 7:00 AM	4,151.8 4,169.5	4,126.0 4,143.7	16.6 17.7	15.9 17.7	NR NR	NR NR	NA NA	28 28	16 16	20 19	15 15	12 12	8 9	13 13	260 275	1,456.0 1,740.0	271,500 284,000	279 267	638 639	621 622	2556.1 2565.6	11.5 9.5	9.8 17.4	4.8 8.1	3.6 5.0	3.6 3.1
40	Thu	05/10/07	7:00 AM	4,186.6	4,161.5	17.1	17.8	NR	NR NR	NA	28	20	17	15	8	11	13	265	2,022.3	282,300	270	641	623	2585.8	20.2	4.6	10.3	3.7	3.8
	Fri Sat	05/11/07 05/12/07	7:00 AM 4:00 PM	4,204.3 4,236.2	4,179.2 4,203.1	17.7 31.9	23.9	NR NR	NR	NA NA	24 28	23 22	16	15 15	6	8 12	9 13	302 280	2,307.8 2,582.6	285,500 274,800	269 168	644	625 627	2602.0 2615.0	16.2 13.0	0.0 4.5	6.8 0.0	0.0 5.0	3.7
-	Sun	05/13/07 05/14/07	9:00 AM 7:00 AM	4,240.5 4,258.6	4,215.0 4,233.1	4.3 18.1	11.9 18.1	NR NR	NR NR	NA NA	26 25	17 17	22 22	15 15	9 8	3	11 10	265 305	2,890.4 3,187.1	307,800 296,700	812 273	646 648	629 631	2627.5 2641.9	12.5 14.4	7.2 5.6	1.6 0.2	4.0 2.1	0.0
	Tue	05/15/07	7:00 AM	4,275.5	4,250.8	16.9	17.7	NR	NR	NA	28	21	16	15	7	12	13	260	184.7	NA	#VALUE!	650	632	2652.6	10.7	2.9	8.6	5.2	5.3
41	Wed Thu	05/16/07 05/17/07	6:50 AM 8:00 AM	4,291.8 4,309.5	4,266.5 4,284.3	16.3 17.7	15.7 17.8	NR NR	NR NR	NA NA	31 26	16 17	19 22	15 14	15 9	12 4	16 12	265 302	443.5 735.2	258,800 291,700	270 274	651 653	634 636	2663.0 2678.2	10.4 15.2	10.3 7.1	5.9 1.1	4.1 2.4	4.1 0.0
	Fri Sat	05/18/07	7:30 AM 7:15 AM	4,328.3 4.342.1	4,303.6 4,317.3	18.8 13.8	19.3 13.7	NR NR	NR NR	NA NA	25 29	18 19	23 16	15 15	7	2 13	10 14	298 271	1,045.6 1,279.0	310,400 233,400	272 283	655 656	638 638	2693.8 2698.7	15.6 4.9	1.3 3.5	3.4 11.2	0.0 5.1	1.3 5.1
	Sun	05/20/07	7:00 AM	4,362.3	4,337.5	20.2	20.2	NR	NR	NA	26	20	15	15	6	11	11	289	1,647.3	368,300	304	659	641	2719.0	20.3	2.5	7.7	1.4	1.4
	Mon Tue	05/21/07 05/22/07	7:15 AM 7:05 AM	4,379.2 4,394.0	4,354.6 4,369.4	16.9 14.8	17.1 14.8	NR NR	NR NR	NA NA	31 32	26 21	17 14	15 15	5 11	14 18	16 17	470 298	2,048.8 2,368.8	401,500 320,000	394 360	664 666	646 648	2752.8 2766.9	33.8 14.1	0.2 4.8	1.9 12.5	0.0 3.9	3.0 5.8
42	Wed Thu	05/23/07 05/24/07	7:00 AM 7:00 AM	4,410.1 4,425.0	4,384.6 4,399.4	16.1 14.9	15.2 14.8	NR NR	NR NR	NA NA	37 29	15 18	15 16	15 15	22 11	22 13	22 14	200 280	2,614.6 2,876.9	245,800 262,300	262 294	666 667	649 650	2770.8 2779.8	3.9 9.0	20.8 11.7	15.2 13.7	11.3 8.1	7.3 8.1
1	Fri	05/25/07	7:00 AM	4,437.5	4,411.8	12.5	12.4	NR	NR	NA	7	12	10	11	NA	NA	NA NA	0	3,139.3	262,400	351	669	652	2794.7	14.9	2.6	3.1	6.4	6.3
	Sat Sun	05/26/07	8:45 AM 8:35 AM	4,453.4 4,470.8	4,427.7 4,444.2	15.9 17.4	15.9 16.5	NR NR	NR NR	NA NA	7 29	12 17	10 18	11 15	NA 12	NA 11	NA 14	265	15.3 445.0	NA 429,700	#VALUE! 423	670 670	653 654	2803.8 2811.1	9.1 7.3	4.2 21.6	15.0	4.1 10.3	7.8 6.0

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet (Continued)

																Pressure F	iltration								Paol	wash			
									KMnO <sub>4</sub>							r lessule r	ilitation								Басі	wasii	Since	Last BW	
				Tank A Hour	Tank B Hour	TA Run	TB Run	KMnO₄ Tank 1	Tank 2 Level	Estimated KMnO <sub>4</sub>		Outlet	Outlet				Inlet-	Flow	Totalizer to	Gallon	Daily Average	Tank	Tank	Total	Daily	Run Time	Run Time	Standby	Standby Time
Week	Day of			Meter	Meter	Time	Time	Level <sup>(a)</sup>	(Iron)	Dosage	Influent	Tank A	Tank B	Effluent	Inlet-TA	Inlet-TB	Effluent	rate	Distribution	Usage	Flowrate	Α	В	Volume	Volume	Tank A	Tank B	Tank A	Tank B
No.	Week Mon	Date 05/28/07	9:00 AM	hrs 4.490.9	hrs 4.464.6	hrs 20.1	hrs 20.4	inches	inches NR	μg/Las Mn NA	psig 26	psig 23	psig 15	psig 15	psig 3	psig 11	psig 11	<b>gpm</b> 298	kgal 785.7	gal 340,700	<b>gpm</b> 280	No. 672	No. 656	kgal 2833.2	<b>kgal</b> 22.1	<b>hrs</b> 2.6	hrs 11.8	hrs 0.9	3.3
	Tue	05/29/07 05/30/07	7:05 AM 7:00 AM	4,507.9 4.523.0	4,481.5 4,496.5	17.0 15.1	16.9 15.0	NR NR	NR NR	NA NA	7 27	13 21	11 15	15 15	NA 6	NA 12	NA 12	0 295	1,072.1 1,329.3	286,400 257,200	282 285	673 674	656 657	2842.0 2848.9	8.8 6.9	5.1 5.0	14.3 13.2	3.7	3.7 7.2
43	Thu	05/30/07	9:00 AM	4,523.0 4,535.5	4,496.5	15.1	15.0	NR	NR	NA	40	37	34	15	3	6	12 25	200	1,329.3	299,700	403	676	659	2848.9 2862.7	13.8	1.7	5.2	0.8	6.1
	Fri Sat	06/01/07	7:40 AM 9:10 AM	4,545.4 4,557.3	4,518.6 4.530.6	9.9	9.8	NR NR	NR NR	NA NA	32 39	21 24	16 60	15 13	11 15	16 NA	17 26	433	1,887.5 2 182 8	258,500 295,300	437	677 679	661 662	2873.2 2887.6	10.5 14.4	5.5 4.0	2.1	8.1 7.5	5.3 0.0
	Sun	06/03/07	9:15 AM	4,570.9	4,543.8	13.6	13.2	NR	NR	NA	38	2	26	14	NA	12	24	275	2,504.3	321,500	400	680	664	2895.7	8.1	0.0	6.1	0.0	7.0
	Mon Tue	06/04/07 06/05/07	7:00 AM 6:55 AM	4,582.0 4,592.1	4,554.9 4,565.3	11.1 10.1	11.1 10.4	NR NR	NR NR	NA NA	39	12 24	10 0	10 14	NA 15	NA 39	NA 25	251	2,785.7 2,929.3	281,400 143,600	423 234	681 683	665 666	2908.3 3054.8	12.6 146.5	11.6 3.1	6.3 0.0	8.1 6.7	6.8 0.0
44	Wed Thu	06/06/07	7:05 AM 7:05 AM	4,603.4 4.614.8	4,576.6 4.587.7	11.3 11.4	11.3 11.1	NR NR	NR NR	NA NA	7 34	12 19	10 24	10 15	NA 15	NA 10	NA 19	0 409	63.6 346.9	NA 283.300	#VALUE! 420	685 686	668 670	2944.7 2954.2	NA 9.5	0.8 6.4	4.9 2.9	0.6 5.6	7.1 5.6
**	Fri	06/08/07	7:05 AM	4,626.9	4,599.7	12.1	12.0	NR	NR	NA	7	11	10	10	NA	NA	NA	0	652.4	305,500	423	688	672	2968.3	14.1	5.6	0.4	4.7	0.0
	Sat Sun	06/09/07	7:10 AM 7:05 AM	4,636.6 4,650.1	4,609.6 4,622.7	9.7 13.5	9.9 13.1	NR NR	NR NR	NA NA	6 32	12 25	10 21	10 15	NA 7	NA 11	NA 17	436	910.5 1,246.7	258,100 336,200	439 421	690 692	673 675	2978.9 2992.8	10.6 13.9	2.2	4.4 5.3	7.1 6.2	8.1 7.1
	Mon Tue	06/11/07	6:55 AM 7:00 AM	4,664.8 4,677.5	4,637.3 4.649.9	14.7	14.6 12.6	NR NR	NR NR	NA NA	31 37	21	27 30	17 15	10 NA	4 7	14	445 340	1,614.2 1,929.1	367,500 314,900	418 415	694 696	678 680	3000.0 3023.8	7.2 23.8	4.0 0.0	0.8	5.8 0.0	0.9
	Wed	06/13/07	7:00 AM	4,689.6	4,662.3	12.7 12.1	12.4	NR	NR	NA	32	24	21	15	8	11	22 17	427	2,245.9	316,800	431	698	681	3034.2	10.4	4.9	7.7	4.9	4.9
45	Thu Fri	06/14/07 06/15/07	7:00 AM 7:05 AM	4,702.6 4,713.8	4,674.8 4,685.6	13.0 11.2	12.5 10.8	NR NR	NR NR	NA NA	40 40	22 34	6 38	12 40	18 6	34 2	28 0	235 223	2,568.8 2,853.8	322,900 285,000	422 432	700 702	683 686	3048.1 3065.3	13.9 17.2	3.3 5.4	0.0 1.0	5.0 6.2	0.0
	Sat	06/16/07	8:50 AM 1:00 AM	4,725.6 4 740.4	4,697.4 4,713.1	11.8	11.8	NR NR	NR NR	NA NA	33	18	28	12	15	5	21	429 475	3,177.3 296.8	323,500 NA	457 #VALUE!	704	688	3079.2 3097.4	13.9	5.3	0.8	6.8	0.0
	Mon	06/17/07	7:30 AM	4,740.4	4,713.1	9.9	9.8	NR NR	NR NR	NA NA	39	24	0	30	15	39	9	267	542.5	245,700	416	707	691	3104.3	6.9	3.4	0.0	6.0	0.0
	Tue Wed	06/19/07 06/20/07	7:05 AM 7:05 AM	4,761.1 4,771.0	4,733.6 4,743.2	10.8 9.9	10.7 9.6	NR NR	NR NR	NA NA	31 31	29	20 26	29 28	9	11	2	476 455	815.9 1,074.4	273,400 258,500	424 442	710 711	693 695	3119.2 3129.5	14.9 10.3	0.0 3.8	5.3 1.4	0.0 6.9	6.0 4.0
46	Thu	06/21/07	7:13 AM	4,782.3	4,754.6	11.3	11.4	NR	NR	NA	33	20	25	27	13	8	6	435	1,364.3	289,900	426	712	696	3136.8	7.3	8.9	4.1	10.0	6.4
	Fri Sat	06/22/07 06/23/07	7:10 AM 8:55 AM	4,795.1 4,809.0	4,768.3 4,789.2	12.8 13.9	13.7 20.9	NR NR	NR NR	NA NA	33 32	21 28	19 17	27 27	12 4	14 15	6 5	380 400	1,666.0 1,999.1	301,700 333,100	380 333	714 716	697 699	3155.1 3170.0	18.3 14.9	4.1 1.3	7.4 7.2	6.1 0.0	6.0
-	Sun Mon	06/24/07 06/25/07	11:00 AM 7:00 AM	4,822.7 4,833.1	4,795.5 4,806.3	13.7	6.3 10.8	NR NR	NR NR	NA NA	31 30	19 27	24 18	25 16	12 3	7 12	6 14	400 410	2,324.2 2,586.8	325,100 262,600	628	717 719	701 702	3181.4 3192.6	11.4 11.2	6.9 0.9	2.8 5.7	7.2 0.2	2.7 6.5
	Tue	06/26/07	7:00 AM	4,844.7	4,818.0	11.6	11.7	NR	NR	NA	6	12	11	11	NA	NA	NA	0	2,864.2	277,400	397	720	704	3203.2	10.6	9.1	0.9	6.3	0.4
47	Wed Thu	06/27/07	7:00 AM 7:15 AM	4,856.3 4,867.2	4,829.7 4,840.1	11.6 10.9	11.7 10.4	NR NR	NR NR	NA NA	32	19 19	23	15 15	13 14	9 11	17 18	385 370	3,140.2 123.1	276,000 NA	395 #VALUE!	721 722	705 706	3211.3 3218.9	8.1 7.6	7.8 9.9	4.4 6.0	6.7 10.8	5.2 7.5
	Fri	06/29/07	7:00 AM	4,878.9	4,851.9	11.7	11.8	NR	NR	NA	32	23	19	16	9	13	16	390	398.3	275,200	390	724	707	3239.5	20.6	5.8	7.8	0.3	8.6
	Sat Sun	06/30/07 07/01/07	7:00 AM 7:00 AM	4,890.2 4,900.0	4,862.6 4,873.4	11.3 9.8	10.7 10.8	NR NR	NR NR	NA NA	29	11 28	12 20	11 15	NA 1	NA 9	NA 14	429	657.2 914.6	258,900 257,400	393 417	725 727	709 710	3245.9 3257.8	6.4 11.9	7.7 0.0	2.1 5.6	9.2 0.0	5.6 9.0
	Mon Tue	07/02/07 07/03/07	7:00 AM 7:00 AM	4,911.7 4.923.3	4,885.3 4,896.7	11.7 11.6	11.9 11.4	NR NR	NR NR	NA NA	30 29	25 21	20 27	16 16	5 8	10	14 13	416 451	1,198.6 1,469.1	284,000 270,500	401 392	728 729	711 713	3265.3 3276.2	7.5 10.9	2.3 5.3	6.2 0.0	8.3 5.7	8.9 0.0
	Wed	07/04/07	7:05 AM	4,933.7	4,907.1	10.4	10.4	NR	NR	NA	29	21	27	16	8	2	13	432	1,713.3	244,200	391	730	714	7.0	NA	6.3	0.0	6.8	0.0
48	Thu Fri	07/05/07	7:05 AM 6:57 AM	4,944.6 4,954.6	4,918.1 4,929.1	10.9 10.0	11.0 11.0	NR NR	NR NR	NA NA	6	11 12	6	15 10	NA NA	NA NA	NA NA	0	1,986.4 2,241.0	273,100 254,600	416 405	731 733	715 716	14.6 25.5	7.6 10.9	7.9 0.7	2.0 8.8	9.9 1.7	6.2 9.3
	Sat	07/07/07	10:00 AM 9:15 AM	4,965.3 4,976.9	4,940.6 4,950.2	10.7 11.6	11.5 9.6	NR NR	NR NR	NA NA	32 29	21	14 27	15 17	11 7	18 2	17 12	439 456	2,491.6 2,781.7	250,600 290,100	377 460	734 735	715 719	34.1 43.7	8.6 9.6	4.8 4.6	12.5	3.9 8.7	5.8
	Mon	07/09/07	NR	NR	NR	NA	NA	NR	NR	NA	NR	NR	NR	NR	NA	NA	NA	NR	NR	NA	#VALUE!	NR	NR	NR	NA	NR	NR	NR	NR
	Tue Wed	07/10/07	7:00 AM 7:00 AM	5,003.5 5.019.1	4,962.1 4,962.1	26.6 15.6	11.9 0.0	NR NR	NR NR	NA NA	46 39	3 24	0	11 12	43 15	NA 39	NA 27	262	34.0 297.2	NA 263,200	#VALUE! #DIV/0!	739 741	720 720	62.3 70.0	18.6 NA	9.0	1.2	0.0 4.1	1.8
49	Thu Fri	07/12/07 07/13/07	7:00 AM 7:05 AM	5,034.6 5,050.9	4,962.1 4,962.1	15.5 16.3	0.0	NR NR	NR NR	NA NA	38 46	25 47	0	15 10	13 NA	38 46	23 36	260	568.3 842.8	271,100 274,500	#DIV/0! #DIV/0!	744 747	720 720	84.2 96.0	14.2 11.8	4.0 0.0	1.2 0.0	4.0 9.2	1.8 1.8
	Sat	07/14/07	10:00 AM	5,070.0	4,962.1	19.1	0.0	NR	NR	NA	38	25	0	15	13	38	23	262	1,174.7	331,900	#DIV/0!	751	720	109.5	13.5	3.7	1.2	2.1	1.8
-	Sun	07/15/07	9:30 AM 7:10 AM	5,083.4 5,097.7	4,962.1 4,962.1	13.4	0.0	NR NR	NR NR	NA NA	40 38	33 23	0	29 14	7 15	40 38	11 24	175 267	1,407.1 1,647.0	232,400	#DIV/0!	754 757	720 720	119.9 130.7	10.4	3.0 4.0	1.2	2.3 3.9	1.8
	Tue	07/17/07	7:25 AM	5,112.4	4,962.1	14.7	0.0	NR	NR	NA	37	27	0	15	10	37	22	283	1,907.3	260,300	#DIV/0!	761	720	145.2	14.5	2.4	1.2	3.5	1.8
50	Wed Thu	07/18/07 07/19/07	10:00 AM 7:10 AM	5,129.5 5,140.7	4,962.1 4,969.8	17.1 11.2	0.0 7.7	NR NR	NR NR	NA NA	36 32	29 24	19	14 16	8	36 13	22 16	305 402	2,187.2 2,448.0	279,900 260,800	#DIV/0! 476	765 767	720 722	159.8 173.8	14.6 14.0	1.9 2.8	1.2 7.7	0.0 6.2	1.8 7.3
	Fri Sat	07/20/07	7:00 AM 7:10 AM	5,151.6 5.161.7	4,981.2 4.991.4	10.9	11.4 10.2	NR NR	NR NR	NA NA	30 31	29 25	19 20	15 15	1	11	15 16	414	2,713.2 2.959.8	265,200 246,600	397 405	769 770	723 724	184.6 191.7	10.8 7.1	0.1 3.1	10.1 9.2	0.0 6.8	9.6
	Sun	07/22/07	7:00 AM	5,174.5	5,004.1	12.8	12.7	NR	NR	NA	32	20	25	16	12	7	16	415	3,262.7	302,900	396	771	726	201.8	10.1	8.3	3.7	7.5	4.4
	Mon Tue	07/23/07 07/24/07	7:10 AM 7:10 AM	5,186.4 5,198.5	5,016.7 5,028.6	11.9 12.1	12.6 11.9	NR NR	NR NR	NA NA	33	24	20 19	17 18	9 12	13 14	16 15	400 386	292.1 587.3	NA 295,200	#VALUE! 410	773 775	727 729	212.5 224.8	10.7 12.3	3.5 0.0	7.3 5.6	6.4 0.0	7.8 9.0
51	Wed Thu	07/25/07 07/26/07	7:05 AM NR	5,210.9 5,222.5	5,040.5 5,052.6	12.4 11.6	11.9 12.1	NR NR	NR NR	NA NA	33 32	18 26	25 17	16 15	15 6	8 15	17 17	374 416	882.0 1,169.4	294,700 287.400	404 404	776 778	731 732	237.0 249.6	12.2 12.6	8.4 0.1	2.2 5.8	8.9 0.0	5.5 7.2
31	Fri	07/27/07	NR	5,234.7	5,065.1	12.2	12.5	NR	NR	NA	29	28	20	18	1	9	11	447	1,457.4	288,000	389	780	734	262.6	13.0	0.2	4.7	0.0	5.0
	Sat	07/28/07	11:00 AM 1:00 AM	5,247.4 5,258.5	5,077.6 5,089.5	12.7 11.1	12.5 11.9	NR NR	NR NR	NA NA	32 NR	18 NR	26 NR	16 NR	14 NA	6 NA	16 NA	404 NR	1,757.5 2,052.5	300,100 295,000	397 428	781 783	736 738	273.5 288.2	10.9 14.7	6.3 3.1	2.4 0.8	6.9 1.0	0.0 8.1
	Mon	07/30/07	7:30 AM 7:45 AM	5,266.5 5,278.7	5,097.8 5,109.6	8.0	8.3 11.8	NR NR	NR NR	NA NA	39 NR	24 NR	3 NR	14 NR	15 NA	36 NA	25	276 NR	2,243.6 2,534.3	191,100	391 404	784 786	738	291.9	3.7	4.2	0.0	5.4	0.0
	Tue Wed	08/01/07	7:00 AM	5,289.2	5,119.3	12.2 10.5	9.7	NR	NR	NA	38	24	1	14	14	37	NA 24	260	2,780.4	246,100	407	787	741	314.2	15.2 7.1	3.5	0.0	6.6	0.0
52	Thu Fri	08/02/07 08/03/07	7:10 AM 7:00 AM	5,300.7 5,310.7	5,130.5 5,140.7	11.5 10.0	11.2 10.2	NR NR	NR NR	NA NA	32 31	19 24	24 21	15 17	13 7	8 10	17 14	388 422	3,048.9 30.3	268,500 NA	394 #VALUE!	788 790	743 744	326.6 338.8	12.4 12.2	8.2 2.5	3.8 5.6	7.5 6.0	5.2 7.3
	Sat	08/04/07	10:00 AM	5,324.8	5,155.5	14.1	14.8	NR	NR	NA	31	28	19	17	3	12	14	413	363.7	333,400	385	792	746	376.6	37.8	1.1	5.2	0.0	6.3
-	Sun Mon	08/05/07 08/06/07	7:20 AM	NR 5,349.0	NR 5,179.7	NA NA	NA NA	NR NR	NR NR	NA NA	NR 40	NR 40	NR 40	NR 50	NA NA	NA NA	NA NA	NR 204	NR 952.8	NA 589,100	#VALUE!	NR 794	NR 749	NR 391.7	NA NA	NR 7.8	NR 2.7	NR 6.5	NR 4.7
	Tue	08/07/07 08/08/07	7:30 AM 7:30 AM	5,361.5 5.374.0	5,191.6 5,204.3	12.5 12.5	11.9 12.7	NR NR	NR NR	NA NA	30 29	23 28	25 21	27 17	7	5 8	3 12	444 447	1,251.9 1.555.5	299,100 303,600	409 402	795 797	750 751	410.2 438.7	18.5 28.5	7.0 0.2	3.9 4.7	6.7 0.0	6.8 5.0
53	Thu	08/09/07	7:05 AM	5,386.6	5,216.6	12.6	12.3	NR	NR	NA	33	20	22	16	13	11	17	379	1,859.2	303,700	407	798	753	453.4	14.7	7.1	4.5	5.7	5.7
	Fri Sat	08/10/07	7:05 AM 7:10 AM	5,400.1 5.412.8	5,230.5 5,242.7	13.5 12.7	13.9 12.2	NR NR	NR NR	NA NA	38 32	26 20	2 25	14 15	12 12	NA 7	24 17	285 415	2,181.4 2.482.3	322,200 300,900	392 403	800 801	754 756	468.3 479.8	14.9 11.5	4.4 8.1	0.0 3.4	4.1 6.3	0.0 5.2
	Sun	08/12/07	7:25 AM	5,425.7	5,256.0	12.9	13.3	NR	NR	NA	30	27	21	16	3	9	14	427	2,791.7	309,400	394	803	757	491.9	12.1	1.5	7.6	5.2	7.2

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet (Continued)

																Pressure F	-::								DI	wash			$\Box$
									KMnO₄							Pressure F	litration								Вас	cwasn	Since I	Last BW	
								KMnO <sub>4</sub>	Tank 2	Estimated											Daily					Run	Run		Standby
l	l			Tank A Hour		TA Run	TB Run	Tank 1	Level	KMnO <sub>4</sub>		Outlet	Outlet				Inlet-	Flow	Totalizer to	Gallon	Average	Tank	Tank	Total	Daily	Time	Time	Time	Time
Week	Day of Week	Date	Time	Meter hrs	Meter hrs	Time	Time hrs	Level <sup>(a)</sup>	(Iron) inches	Dosage	Influent psig	Tank A psig	Tank B psig	Effluent psig	Inlet-TA psig	Inlet-TB psig	Effluent psig	rate gpm	Distribution kgal	Usage gal	Flowrate gpm	A No.	B No.	Volume kgal	Volume kgal	Tank A hrs	Tank B hrs	Tank A hrs	Tank B hrs
110.	Mon	08/13/07	6:55 AM	5,440.5	5,270.5	14.8	14.5	NR	NR	NA NA	32	21	24	17	11	8	15	399	3,138.3	656,000	746	804	759	503.0	11.1	8.0	4.8	5.6	5.2
	Tue Wed	08/14/07	6:55 AM 7:05 AM	5,451.9 5,471.0	5,282.5 5,301.6	11.4 19.1	12.0 19.1	NR NR	NR NR	NA NA	32 27	26 21	20 14	16 15	6	12 13	16 12	404 244	153.3 453.8	NA 300,500	#VALUE! 262	806 807	760 761	515.8 533.7	12.8 17.9	3.2	7.1 17.6	5.9 0.9	6.6 3.5
54	Thu	08/16/07	7:05 AM	5,483.8	5,313.1	12.8	11.5	NR NR	NR	NA NA	33	20	29	15	13	4	18	494	749.6	295,800	407	808	764	552.5	18.8	6.2	0.0	6.7	0.0
	Fri	08/17/07	7:05 AM	5,500.9	5,330.4	17.1	17.3	NR	NR	NA	25	15	20	13	10	5	12	273	1,047.0	297,400	288	810	766	567.5	15.0	13.3	3.3	4.5	3.8
	Sat Sun	08/18/07 08/19/07	10:00 AM 10:00 AM	5,512.4 5.526.0	5,342.9 5.355.6	11.5 13.6	12.5 12.7	NR NR	NR NR	NA NA	32 31	29 21	19 27	17 16	3 10	13	15 15	404 418	1,339.5 1,639.4	292,500 299,900	407 381	812 813	767 769	578.3 588.7	10.8 10.4	1.0 4.7	5.7 0.8	0.0 6.8	8.0 0.0
	Mon	08/20/07	7:15 AM	5,538.1	5,367.4	12.1	11.8	NR	NR	NA	32	20	25	15	12	7	17	428	1,921.1	581,600	811	815	770	596.7	8.0	8.0	3.1	6.0	4.8
	Tue	08/21/07	7:10 AM	5,549.3	5,379.6	11.2	12.2	NR	NR	NA	32	25	19	16	7	13	16	379	2,192.1	271,000	387	816	771	606.4	9.7	3.9	8.1	5.1	6.4
55	Wed Thu	08/22/07 08/23/07	7:30 AM 7:14 AM	5,561.4 5.574.0	5,391.2 5,404.2	12.1 12.6	11.6 13.0	NR NR	NR NR	NA NA	32 33	18 24	26 20	16 17	14 9	6 13	16 16	404 400	2,474.1 2,785.1	282,000 311.000	397 405	817 819	773 775	617.3 628.1	10.9 10.8	6.0 4.3	4.4 1.1	6.0 5.9	6.1 0.0
**	Fri	08/24/07	7:10 AM	5,585.8	5,416.7	11.8	12.5	NR	NR	NA	30	29	19	18	NA	11	12	412	3,066.8	281,700	387	821	776	641.8	13.7	0.1	5.6	0.0	5.7
	Sat	08/25/07	7:30 AM 7:00 AM	5,596.9 5.610.4	5,427.8 5.440.9	11.1 13.5	11.1	NR NR	NR NR	NA NA	33 33	25 20	19 24	17 16	8 13	14 9	16 17	318 370	47.5 351.3	NA 303.800	#VALUE! 381	822 823	777 779	648.8 659.2	7.0 10.4	3.1 8.8	8.2 4.2	7.3 7.3	9.1 6.1
	Mon	08/27/07	7:30 AM	5,624.6	5,454.4	14.2	13.5	NR	NR	NA NA	31	21	28	16	10	3	15	407	664.6	617,100	743	825	781	673.2	14.0	5.4	0.2	5.4	0.0
	Tue	08/28/07	6:55 AM	5,634.9	5,464.4	10.3	10.0	NR	NR	NA	30	23	28	16	7	2	14	425	899.0	234,400	385	826	782	681.3	8.1	7.0	0.0	7.3	0.0
56	Wed Thu	08/29/07 08/30/07	7:00 AM 7:03 AM	5,646.5 5.657.7	5,475.9 5.487.0	11.6 11.2	11.5 11.1	NR NR	NR NR	NA NA	31 32	23 20	25 22	16 16	8 12	6 10	15 16	407 NR	1,161.9 1,416.1	262,900 254,200	379 380	827 828	783 784	690.4 703.7	9.1 13.3	6.5 6.4	2.7 4.1	7.5 6.0	6.3 5.9
**	Fri	08/31/07	7:00 AM	5,678.0	5,507.5	20.3	20.5	NR	NR	NA	27	18	13	14	9	14	13	NR	1,587.5	171,400	140	829	785	720.3	16.6	5.9	14.3	0.0	0.0
	Sat	09/01/07	9:30 AM 10:00 AM	5,696.6 5,717.0	5,525.3 5,545.9	18.6 20.4	17.8 20.6	NR NR	NR NR	NA NA	22	15 16	20	13	7	2	9	NR NR	1,587.9 NR	400 NA	0 #VALUE!	830 831	787 788	733.6 743.0	13.3 9.4	1.0 11.9	1.9	3.5 4.0	0.0
<b>-</b>	Mon	09/03/07	NR	5,717.0	5,563.7	18.2	17.8	NR	NR	NA NA	15	21	14	NR	NA NA	NA NA	NA.	NR	NR NR	NA NA	#VALUE!	832	787	751.0	8.0	5.9	11.2	0.0	0.0
	Tue	09/04/07	7:10 AM	5,753.3	5,582.0	18.1	18.3	NR	NR	NA	31	23	24	17	8	7	14	NR	NR	NA	#VALUE!	833	790	762.0	11.0	7.0	4.3	3.3	3.3
57	Wed	09/05/07	7:25 AM 7:40 AM	5,772.4 5,792.9	5,601.3 5,621.8	19.1 20.5	19.3 20.5	NR NR	NR NR	NA NA	24 25	20 19	14 14	13 12	6	10	11	NR NR	NR NR	NA NA	#VALUE!	834 835	791 792	774.3 782.0	12.3 7.7	4.7 5.1	13.1 16.7	1.9	2.0
0.	Fri	09/07/07	7:10 AM	5,809.0	5,637.6	16.1	15.8	NR	NR	NA	32	2	17	12	30	NA	20	NR	NR	NA	#VALUE!	836	794	793.8	11.8	0.0	6.2	0.0	3.2
	Sat	09/08/07	8:30 AM	5,827.5 5,841.7	5,656.5 5,670.6	18.5	18.9 14.1	NR NR	NR NR	NA	31	30	20 18	12 17	1	11	19 14	NR NR	NR NR	NA NA	#VALUE!	838	795 797	780.0 821.0	NA 41.0	0.0	11.1 4.2	0.0	3.9
-	Mon	09/09/07	7:00 AM	5,841.7	5,670.6	14.2 28.5	28.3	NR NR	NR NR	NA NA	31 26	30 16	16	14	10	13 10	12	NR NR	NR NR	NA NA	#VALUE!	840 841	797	821.0	10.4	0.2 9.1	6.2	5.4	6.2 5.4
	Tue	09/11/07	7:00 AM	NR	NR	NA	NA	NR	NR	NA	28	15	18	14	13	10	14	NR	NR	NA	#VALUE!	842	801	842.0	10.6	18.8	6.6	3.9	0.0
58	Wed	09/12/07	6:55 AM 7:05 AM	5,885.8 5,896.7	5,714.6 5.724.9	29.8 10.9	29.8 10.3	NR NR	NR NR	NA NA	41 33	43 26	39 19	0 16	-2 7	14	41 17	NR 345	NR 1 746 6	NA 158 700	#VALUE! 250	844 845	802 803	853.2 860.3	11.2 7.1	0.6 3.4	6.6 9.2	0.2 6.5	6.7 11.5
36	Fri	09/14/07	7:00 AM	5,907.1	5,735.2	10.9	10.3	NR	NR	NA NA	21	20	16	15	1	5	6	250	1,740.0	215,200	347	846	804	867.7	7.4	3.7	9.7	6.3	10.8
	Sat	09/15/07	8:30 AM	5,919.7	5,747.2	12.6	12.0	NR	NR	NA	20	23	28	17	-3	-8	3	386	2,216.9	255,100	346	847	806	886.7	19.0	5.0	0.0	5.4	0.0
-	Sun	09/16/07	8:30 AM 7:05 AM	5,930.3 5,943.5	5,758.5 5,771.4	10.6 13.2	11.3 12.9	NR NR	NR NR	NA NA	30 30	24 20	27 25	18 16	6 10	3 5	12	388	2,449.7 2.714.6	232,800	355 338	848 849	807 808	904.8	18.1 12.5	5.3 9.0	0.9	8.3 8.2	0.8 6.1
	Tue	09/18/07	7:20 AM	5,955.6	5,784.3	12.1	12.9	NR	NR	NA	31	30	20	17	1	11	14	363	2,974.6	260,000	347	851	809	944.1	26.8	0.5	7.2	0.0	6.5
59	Wed Thu	09/19/07	7:35 AM 8:06 AM	5,968.5 5.981.3	5,797.1 5.808.9	12.9 12.8	12.8 11.8	NR NR	NR NR	NA NA	33 32	27 22	19 29	17 16	6 10	14 3	16 16	348 364	3,240.0 228.5	265,400 NA	344 #VALUE!	852 853	810 812	962.1 988.5	18.0 26.4	3.1 6.0	9.3 0.7	4.1 5.8	5.4 0.0
59	Fri	09/20/07	9:00 AM	5,996.8	5,824.6	15.5	15.7	NR NR	NR	NA NA	30	13	10	17	17	20	13	387	497.2	268,700	287	854	813	1006.5	18.0	6.4	4.4	4.3	4.3
	Sat	09/22/07	8:00 AM	6,008.6	5,836.3	11.8	11.7	NR	NR	NA	NR	NR	NR	NR	NA	NA	NA	NR	743.6	246,400	350	856	815	1024.5	18.0	7.5	5.7	5.8	5.8
-	Sun	09/23/07	7:40 AM 7:00 AM	6,029.2 6.033.6	5,855.4 5,861.3	20.6	19.1 5.9	NR NR	NR NR	NA NA	32 31	20 26	29 21	16 16	12 5	3 10	16 15	356 373	1,172.6 1,284.7	429,000 112,100	361 371	857 858	817 817	1069.0 1078.2	44.5 9.2	7.8 3.3	0.4 5.7	3.3 5.7	0.0 5.7
	Tue	09/25/07	7:19 AM	6,036.5	5,876.5	2.9	15.2	NR	NR	NA	38	4	31	15	NA	7	23	276	1,530.0	245,300	839	858	821	1091.0	12.8	6.2	1.0	6.6	0.0
60	Wed Thu	09/26/07 09/27/07	7:00 AM 7:00 AM	6,036.5 6,036.5	5,892.6 5,905.0	0.0	16.1 12.4	NR NR	NR NR	NA NA	38 36	4	32 23	15 20	NA NA	6 13	23 16	277 136	1,778.4 1,913.6	248,400 135,200	#DIV/0! #DIV/0!	858 858	826 828	1107.1 1113.8	16.1 6.7	6.2	0.7 5.2	6.6	0.0 6.2
60	Fri	09/28/07	7:00 AM	6,036.5	5,905.0	0.0	16.3	NR NR	NR	NA NA	39	6	28	15	NA NA	11	24	273	2,166.4	252,800	#DIV/0!	858	833	1130.5	16.7	6.2	1.8	6.6	0.0
	Sat	09/29/07	8:30 AM	6,036.5	5,935.2	0.0	13.9	NR	NR	NA	34	6	29	16	NA NA	5	18	245	2,342.2	175,800	#DIV/0!	858	836	1140.5	10.0	6.2	1.6	6.6	0.9
-	Sun	09/30/07 10/01/07	8:00 AM 7:50 AM	6,036.5 6,036.5	5,950.0 5,965.7	0.0	14.8 15.7	NR NR	NR NR	NA NA	38 38	- 6 - 7	24 30	17 17	NA NA	14 8	21 21	200	2,520.8 2,715.1	178,600 194,300	#DIV/0! #DIV/0!	858 858	837 840	1143.9 1156.1	3.4 12.2	6.2	9.7 2.5	6.6	6.1 3.6
	Tue	10/02/07	7:27 AM	6,036.5	5,980.4	0.0	14.7	NR	NR	NA	39	6	31	18	NA	8	21	262	2,915.4	200,300	#DIV/0!	858	843	1165.9	9.8	6.2	0.8	6.6	0.0
61	Wed Thu	10/03/07	8:52 AM 7:35 AM	6,036.5 6,036.5	5,995.1 6.008.8	0.0	14.7	NR NR	NR NR	NA NA	35 36	6	27 30	19 18	NA NA	8	16 18	248	3,114.3 29.5	198,900 NA	#DIV/0! #VALUE!	858 858	845 848	1173.2 1183.9	7.3 10.7	6.2 6.2	3.6	6.6 6.6	1.2
01	Fri	10/04/07	7:35 AM 7:15 AM	6,036.5	6,022.6	0.0	13.7	NR NR	NR NR	NA NA	36	6	31	18	NA NA	5	17	274	29.5	188,700	#VALUE! #DIV/0!	858	851	1183.9	10.7	6.2	0.7	6.6	0.0
	Sat	10/06/07	8:30 AM	6,047.5	6,035.4	11.0	12.8	NR	NR	NA	32	6	28	19	NA	4	13	468	356.0	137,800	194	859	852	1201.0	7.0	1.3	6.1	0.9	8.0
-	Sun	10/07/07	9:00 AM NR	6,066.8	6,054.2	19.3 0.2	18.8 19.5	NR NR	NR NR	NA NA	30 26	17 16	15 19	15 15	13 10	15 7	15 11	201	733.0 988.8	377,000 255.800	330 10.768	859 860	853	1204.3 1224.8	3.3 20.5	2.0 16.7	0.0 5.9	5.7 0.3	0.0
1	Tue	10/09/07	NR	6,097.8	6,084.2	30.8	10.5	NR	NR	NA	36	30	50	16	6	NA.	20	281	1,234.1	245,300	261	862	856	1236.9	12.1	2.1	0.0	3.8	0.0
60	Wed	10/10/07	NR	6,112.4	6,098.5	14.6	14.3	NR	NR	NA NA	31	27	22	16 17	4 6	9	15	378	1,489.9	255,800	295	863	858	1246.0	9.1	3.6	6.5	5.4	5.3
62	Thu Fri	10/11/07	NR NR	6,124.9 6,137.1	6,110.5 6,122.6	12.5 12.2	12.0 12.1	NR NR	NR NR	NA NA	29 31	23 21	27 23	16	10	8	12 15	404 363	1,733.3 1,977.0	243,400 243,700	331 334	864 865	860 861	1256.6 1263.1	10.6 6.5	4.9 7.0	0.1 4.0	5.2 4.2	0.0 4.2
	Sat	10/13/07	NR	6,150.7	6,135.6	13.6	13.0	NR	NR	NA	42	37	39	30	5	3	12	165	2,254.1	277,100	347	866	863	1273.4	10.3	8.3	2.0	8.1	0.0
-	Sun	10/14/07	NR NR	6,160.9 6.175.4	6,146.8 6.160.9	10.2 14.5	11.2 14.1	NR NR	NR NR	NA NA	41 30	57 22	23 26	13 16	NA 8	18 4	28 14	233	2,490.4 2,757.3	236,300 266,900	369 311	868 869	864 866	1283.9 1294.0	10.5 10.1	0.0 4.4	4.9 0.5	0.0 5.0	8.5 0.0
	Tue	10/16/07	7:05 AM	6,191.4	6,161.0	16.0	0.1	NR	NR	NA	40	27	1	15	13	NA	25	253	3,010.7	253,400	21,249	871	866	1307.7	13.7	7.8	0.6	3.2	0.3
	Wed	10/17/07	7:20 AM	6,205.2	6,161.0	13.8	0.0	NR	NR	NA NA	36	33	1	16	3 7	NA NA	20	295	3,222.5	211,800	#DIV/0!	874	866	1320.8	13.1	0.7	0.6	0.0	0.3
63	Thu Fri	10/18/07	7:20 AM 7:15 AM	6,218.6 26.4	6,161.0 6,161.0	13.4 NA	0.0	NR NR	NR NR	NA NA	37 37	30 29	4	16 16	8	NA NA	21	265 260	161.8 349.8	NA 188,000	#VALUE!	876 879	866	1328.2 1338.4	7.4 10.2	2.2	0.6	2.9 4.8	0.3
	Sat	10/20/07	8:00 AM	38.2	6,161.0	11.8	0.0	NR	NR	NA	38	29	4	16	9	NA	22	260	530.3	180,500	#DIV/0!	881	866	1345.3	6.9	3.5	0.6	6.1	0.3
-	Sun Mon	10/21/07	7:45 AM 7:00 AM	51.6 66.9	6,161.0 6,161.0	13.4 15.3	0.0	NR NR	NR NR	NA NA	37 45	31 58	4	16 11	-13	NA NA	21 34	272 NR	725.2 947.3	194,900 222,100	#DIV/0! #DIV/0!	884 886	866	1356.2 1365.2	10.9 9.0	0.7	0.6	0.6	0.3
	Tue	10/22/07	7:00 AM	84.3	6,161.0	17.4	0.0	NR NR	NR	NA NA	36	32	4	15	-13	NA NA	21	275	1,191.8	244,500	#DIV/0!	890	866	1377.3	12.1	0.0	0.6	0.0	0.3
1	Wed	10/24/07	7:45 AM	100.7	6,161.0	16.4	0.0	NR	NR	NA	38	26	29	16	12	NA	22	237	1,384.6	192,800	#DIV/0!	892	866	1389.3	12.0	4.5	0.6	5.9	0.3
64	Thu Fri	10/25/07 10/26/07	7:00 AM	114.3 127.8	6,161.0 6,161.0	13.6 13.5	0.0	NR NR	NR NR	NA NA	37 46	30 52	36 35	15 12	7 -6	NA NA	22 34	264 365	1,591.6 1,782.0	207,000 190.400	#DIV/0! #DIV/0!	895 897	866 866	1394.9 1404.4	5.6 9.5	1.9 0.0	0.6	2.0 0.0	0.3
	Sat	10/27/07	8:30 AM	141.5	6,161.0	13.7	0.0	NR	NR	NA	36	28	23	16	8	NA NA	20	254	1,964.0	182,000	#DIV/0!	900	866	1412.0	7.6	1.9	0.6	2.4	0.3
	Sun	10/28/07	9:30 AM	156.6	6,161.0	15.1	0.0	NR	NR	NA	37	27	22	16	10	NA	21	253	2,181.2	217,200	#DIV/0!	903	866	1422.5	10.5	2.2	0.6	0.8	0.3

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet (Continued)

																D	-:144"									kwash			
									KMnQ.			1				Pressure F	iltration						T		Baci	kwash	Since L	Last BW	
								KMnO <sub>4</sub>	Tank 2	Estimated											Daily					Run	Run		Standby
l	l			Tank A Hour	Tank B Hour	TA Run	TB Run	Tank 1	Level	KMnO₄	l. <u>.</u> .	Outlet	Outlet	l			Inlet-	Flow	Totalizer to	Gallon	Average	Tank	Tank	Total	Daily	Time	Time	Time	Time
Week No.	Day of	Date	Time	Meter hrs	Meter hrs	Time hrs	Time hrs	Level <sup>(a)</sup> inches	(Iron) inches	Dosage µg/L as Mn	Influent psig	Tank A psig	Tank B psig	Effluent	Inlet-TA psig	Inlet-TB psig	Effluent psig	gpm	Distribution kgal	Usage	Flowrate	A No.	B No.	Volume kgal	Volume kgal	Tank A hrs	Tank B hrs	Tank A hrs	Tank B hrs
	Mon	10/29/07	7:00 AM	170.6	6,161.0	14.0	0.0	NR	NR	NA	36	29	22	17	7	NA	19	273	2,376.9	195,700	#DIV/0!	906	866	1432.5	10.0	1.6	0.6	0.0	0.3
	Tue Wed	10/30/07	7:30 AM 7:00 AM	186.1 200.5	6,161.0 6.161.0	15.5 14.4	0.0	NR NR	NR NR	NA NA	36 39	31 25	29	16 16	5 14	NA NA	20	275 217	2,565.6 2,777.5	188,700 211.900	#DIV/0! #DIV/0!	909 911	866	NR 1449.8	NA 17.3	0.3 5.4	0.6	0.0 4.0	0.3
65	Thu	11/01/07	7:00 AM	214.4	6,161.0	13.9	0.0	NR	NR	NA NA	37	27	35	16	10	NA NA	21	240	2,777.3	199,800	#DIV/0!	914	866	1460.5	10.7	3.9	0.6	4.9	0.3
	Fri	11/02/07	7:00 AM	233.1	6,161.0 6.161.0	18.7 14.6	0.0	NR NR	NR NR	NA NA	37 36	27 30	5	16	10	NA	21 19	246	3,187.1	209,800	#DIV/0!	917 920	866	1471.3 1481.8	10.8 10.5	2.5	0.6	3.2	0.3
	Sat	11/03/07	8:25 AM 10:30 AM	247.7 264.9	6,161.0	14.6 17.2	0.0	NR NR	NR NR	NA NA	36 36	23	4	17 16	6 13	NA NA	19 20	260 280	117.8 361.3	-3,069,300 243,500	#DIV/0! #DIV/0!	920	866	1481.8 1492.7	10.5	3.2	0.6	0.5	0.3
	Mon	11/05/07	7:00 AM	278.0	6,161.0	13.1	0.0	NR	NR	NA	36	28	4	17	8	NA	19	251	552.0	190,700	#DIV/0!	926	866	1503.0	10.3	1.5	0.6	0.0	0.3
	Tue	11/06/07	7:00 AM 7:00 AM	293.7 308.8	6,175.6 6,191.4	15.7 15.1	14.6 15.8	NR NR	NR NR	NA NA	29 33	21	24 19	16 15	8 13	5 14	13 18	378 340	833.1 1,121.3	281,100 288,200	310 311	927 929	867 868	1512.1 1524.7	9.1 12.6	8.7 6.0	4.3 8.7	5.5 6.1	5.6 7.0
66	Thu	11/08/07	7:00 AM	321.9	6,204.5	13.1	13.1	NR	NR	NA	30	22	26	16	8	4	14	403	1,374.7	253,400	322	931	870	1538.3	13.6	3.4	0.3	5.1	0.0
	Fri	11/09/07	7:00 AM	332.6	6,216.5	10.7	12.0	NR	NR	NA	32	22	26	17	10	6	15	401	1,552.1	177,400	261	933		1541.3	3.0	4.0	1.4	6.6	2.3
	Sat	11/10/07	7:30 AM 7:30 AM	344.7 356.3	6,228.9 6,240.2	12.1 11.6	12.4 11.3	NR NR	NR NR	NA NA	40 31	27 26	0 22	15 16	13 5	40 9	25 15	270 393	1,923.1 2,187.2	371,000 264,100	505 384	935	873 875	1562.7 1576.5	21.4 13.8	2.5 0.6	0.0 4.6	4.3 1.8	0.0 8.2
	Mon	11/12/07	7:20 AM	368.9	6,252.3	12.6	12.1	NR	NR	NA	32	28	20	15	4	12	17	400	2,467.1	279,900	378	939		1590.5	14.0	0.4	4.3	0.0	6.4
	Tue	11/13/07	7:00 AM 6:55 AM	379.1 388.3	6,261.8 6,271.6	10.2 9.2	9.5 9.8	NR NR	NR NR	NA NA	34 33	19 24	27	15 15	15 9	7	19 18	386	2,696.9 2,929.4	229,800	389 408	940 942		1600.1 1610.4	9.6 10.3	5.0 3.2	0.8 5.1	6.0	7.3
67	Thu	11/15/07	7:00 AM	400.3	6,283.6	12.0	12.0	NR	NR	NA	33	28	19	16	5	14	17	396	3,204.7	275,300	382	944	882	1623.9	13.5	0.7	5.5	0.6	6.5
	Fri Sat	11/16/07	NR 8:30 AM	NR 422.1	NR 6.304.4	NA 21.8	NA 20.8	NR NR	NR NR	NA NA	NR 41	NR 1	NR 25	NR 14	NA 40	NA 16	NA 27	NR 268	NR 441.6	NA NA	#VALUE! #VALUE!	NR 947	NR	NR 1644.9	NA 21.0	NR 0.0	NR 4.2	NR 0.0	NR 7.3
	Sun	11/17/07	8:30 AM 8:00 AM	422.1	6,314.4	9.8	10.0	NR NR	NR NR	NA NA	33	21	25	16	12	9	17	390	668.1	226,500	#VALUE!	947	887	1658.4	13.5	4.2	1.6	8.1	3.8
	Mon	11/19/07	6:50 AM	442.7	6,325.9	10.8	11.5	NR	NR	NA	32	21	26	16	11	6	16	397	924.4	256,300	383	951	889	1672.0	13.6	3.6	0.8	6.6	0.2
	Tue	11/20/07 11/21/07	7:00 AM 6:50 AM	454.3 466.0	6,337.5 6,349.5	11.6 11.7	11.6 12.0	NR NR	NR NR	NA NA	32 31	21 23	27 26	17 16	11 8	5	15 15	400 410	1,191.9 1,463.0	267,500 271,100	384 381	953 955	891 894	1685.7 1702.9	13.7 17.2	4.1 4.5	0.1	5.1 5.4	0.0 1.4
68	Thu	11/22/07	NR	476.5	6,359.9	10.5	10.4	NR	NR	NA	33	24	20	15	9	13	18	377	1,717.3	254,300	406	957	896	1726.1	23.2	3.2	5.1	0.7	7.3
	Fri Sat	11/23/07	8:00 AM 7:23 AM	487.3 498.3	6,371.6 6,382.6	10.8 11.0	11.7 11.0	NR NR	NR NR	NA NA	33 33	27 28	19 18	17 16	- 6 - 5	14 15	16 17	404 388	1,972.4 2,236.6	255,100 264,200	379 400	959 961	897	1726.8 1740.2	0.7 13.4	0.7	4.8 5.2	1.1 0.0	8.1 7.5
	Sun	11/25/07	8:00 AM	508.4	6,390.9	10.1	8.3	NR NR	NR	NA NA	32	21	25	17	11	7	15	386	2,468.5	231,900	424		901	1740.2	12.6	3.5	1.0	6.8	0.7
	Mon	11/26/07	9:47 AM	518.3	6,402.5	9.9	11.6	NR	NR	NA	32	22	24	17	10	8	15	394	2,701.1	232,600	363	964	903	1763.6	10.8	4.0	1.6	7.6	5.4
	Tue	11/27/07	7:00 AM 7:00 AM	530.2 541.0	6,414.4 6,424.9	11.9 10.8	11.9 10.5	NR NR	NR NR	NA NA	41 34	1 22	25 22	15 16	40 12	16 12	26 18	247 367	2,979.5 3.234.7	278,400 255,200	390 399	966 968	905 907	1777.7 1791.5	14.1 13.8	0.0 5.5	3.6 3.1	0.0 6.6	6.5 6.1
69	Thu	11/29/07	7:00 AM	552.3	6,437.2	11.3	12.3	NR	NR	NA	33	28	18	16	5	15	17	380	231.0	NA	#VALUE!	972	909	1811.9	20.4	0.2	4.7	0.0	6.2
	Fri Sat	11/30/07 12/01/07	7:00 AM 8:00 AM	564.4 573.7	6,448.6 6,458.0	12.1 9.3	11.4 9.4	NR NR	NR NR	NA NA	30 38	24 11	26 10	17 16	6 27	4 28	13 22	418 392	506.5 722.2	275,500 215,700	391 385	974 976	912 913	1829.2 1839.9	17.3 10.7	1.0 0.6	0.1 4.5	0.0	0.0 6.6
	Sun	12/01/07	9:00 AM	584.4	6,469.1	10.7	11.1	NR NR	NR	NA NA	30	25	25	17	5	5	13	418	985.0	262,800	402	978	916	1857.4	17.5	1.1	0.6	0.6	0.0
	Mon	12/03/07	6:55 AM	594.7	6,478.9	10.3	9.8	NR	NR	NA	31	27	22	16	4	9	15	401	1,204.5	219,500	364	979	917	1864.8	7.4	0.0	0.0	0.0	0.0
	Tue	12/04/07 12/05/07	7:05 AM 7:00 AM	605.3 616.5	6,489.6 6,500.6	10.6 11.2	10.7 11.0	NR NR	NR NR	NA NA	30 34	25 19	24 26	16 16	5 15	6 8	14 18	404 382	1,418.0 1,693.9	213,500 275,900	334 414	982 983	919 921	1880.8 1891.4	16.0 10.6	1.0 6.5	1.1	0.0 5.8	0.8 1.2
70	Thu	12/06/07	7:00 AM	626.5	6,511.2	10.0	10.6	NR	NR	NA	33	21	25	16	12	8	17	393	1,942.3	248,400	402	985	923	1904.6	13.2	4.5	1.1	6.3	0.8
	Fri Sat	12/07/07	7:00 AM 8:30 AM	637.3 648.0	6,522.6 6,533.8	10.8	11.4	NR NR	NR NR	NA NA	32 32	22	25 25	16 16	10	7	16 16	408 402	2,195.1 2,444.0	252,800 248,900	380 379	987 989	925 927	1918.6 1932.7	14.0 14.1	3.8	0.7 1.0	6.6	0.7
	Sun	12/09/07	9:00 AM	659.7	6,544.4	11.7	10.6	NR	NR	NA NA	40	28	4	15	12	36	25	267	2,695.6	251,600	377		928	1942.8	10.1	2.6	0.0	4.5	0.0
	Mon	12/10/07	7:20 AM	675.1	6,544.1	15.4	-0.3	NR	NR	NA	31	27	21	16	4	10	15	381	2,954.7	259,100	-7,057	996		1960.7	17.9	1.0	0.0	0.0	0.0
	Tue Wed	12/11/07 12/12/07	7:00 AM 7:01 AM	687.7 702.5	6,546.8 6.546.8	12.6 14.8	2.7	NR NR	NR NR	NA NA	38 39	34 31	3	17	8	35 36	21 24	302 285	3,181.1 142.3	226,400 NA	849 #VALUE!	1000	928 928	1975.3 1989.7	14.6 14.4	0.3	0.0	0.0	0.0
71	Thu	12/13/07	7:00 AM	716.3	6,546.8	13.8	0.0	NR	NR	NA	38	34	3	16	4	35	22	290	362.0	219,700	#DIV/0!	1009	928	2007.5	17.8	0.3	0.0	0.0	0.0
	Fri Sat	12/14/07 12/15/07	7:15 AM 7:00 AM	731.4 741.2	6,546.8 6,554.4	15.1 9.8	7.6	NR NR	NR NR	NA NA	38 33	34 26	21	17	7	38 12	21 16	310 370	602.4 822.1	240,400 219,700	#DIV/0! 428	1014 1015	928 928	2024.9 2028.5	17.4 3.6	0.1 3.2	0.0 7.7	7.0	0.0 10.9
	Sun	12/16/07	8:30 AM	758.4	6,555.9	17.2	1.5	NR	NR	NA NA	39	32	3	16	7	36	23	300	1,109.0	286,900	1,733	1019	928	2042.2	13.7	0.8	0.0	0.0	0.0
	Mon Tue	12/17/07	7:00 AM 7:00 AM	774.6 787.2	6,555.9 6,567.2	16.2 12.6	0.0 11.3	NR NR	NR NR	NA NA	46 35	23	3 21	12 16	42 12	43 14	34 19	0 369	1,373.3 1,644.8	264,300 271,500	#DIV/0! 380	1022	928	2052.8 2060.1	10.6 7.3	0.0 6.2	0.0 7.4	0.0 6.5	7.6
	Wed	12/19/07	7:00 AM	798.3	6,577.3	11.1	10.1	NR NR	NR	NA NA	33	24	21	16	9	12	17	383	1,908.8	264,000	416	1024	928 928	2070.3	10.2	3.0	6.6	5.5	7.0
72	Thu	12/20/07	7:00 AM	808.8	6,587.6	10.5	10.3	NR	NR	NA	34	24	21	17	10	13	17	380	2,146.6	237,800	381	1027		2077.4	7.1	4.2	8.7	7.2	10.7
	Fri Sat	12/21/07	7:00 AM 8:30 AM	820.0 830.2	6,598.8 6,608.6	11.2 10.2	11.2 9.8	NR NR	NR NR	NA NA	6 33	19 21	10 26	12	-13 12	-4 7	-6 16	380	2,399.9 2,633.4	253,300 233,500	377 389	1028 1029		2087.9 2094.6	10.5 6.7	7.2 8.2	1.1 2.7	7.2 10.3	0.2 3.9
	Sun	12/23/07	8:13 AM	842.9	6,621.7	12.7	13.1	NR	NR	NA	32	26	21	17	6	11	15	395	2,927.7	294,300	380	1031	933	2105.0	10.4	2.4	6.4	0.0	7.5
	Mon	12/24/07	12:30 PM 10:30 AM	855.3 866.5	6,634.3 6,644.6	12.4 11.2	12.6 10.3	NR NR	NR NR	NA NA	43 32	39 21	37 28	NR NR	11	6	NA NA	191 413	3,217.2 398.0	289,500 NA	386 #VALUE!	1032	934 936	2112.0	7.0 10.5	4.8 6.6	9.5	3.2 8.1	8.4
	Wed	12/26/07	7:00 AM	876.5	6,655.0	10.0	10.3	NR	NR	NA NA	32	22	27	17	10	5	15	413	400.0	2,000	3	1033	937	2122.3	7.2	7.9	0.7	8.3	1.3
73	Thu	12/27/07	7:05 AM	888.6	6,667.2	12.1	12.2	NR	NR	NA	40	1	29	15	39	11	25	288	686.1	286,100	392		938	2136.7	7.0	0.0	3.4	0.8	6.0
	Sat	12/28/07 12/29/07	7:00 AM 8:30 AM	899.3 910.0	6,678.4 6,689.4	10.7 10.7	11.2 11.0	NR NR	NR NR	NA NA	6 8	11	10	14	-5 -3	-4 -2	-8 -3	11	257.0 529.4	-429,100 272,400	-653 419	1037	939 941	8.2 25.0	NA 16.8	1.6 1.8	6.2 0.8	0.3	6.3 0.2
	Sun	12/30/07	8:30 AM	920.9	6,700.8	10.9	11.4	NR	NR	NA	31	23	25	17	8	6	14	423	783.7	254,300	380	1041		32.1	7.1	4.1	2.1	8.4	6.2
	Mon Tue	12/31/07	7:00 AM 1:00 PM	931.8 947.4	6,712.0 6,727.0	10.9 15.6	11.2 15.0	NR NR	NR NR	NA NA	5	11	10 10	14 13	-6 -6	-5 -5	-9 -8	0	1,033.8 1,388.2	250,100 354,400	377 386	1041		35.6 53.0	3.5 17.4	7.9 5.5	3.8 1.5	8.4 7.4	7.6 1.1
	Wed	01/01/08	7:00 PM	956.0	6,736.0	8.6	9.0	NR	NR	NA NA	8	11	10	11	-3	-2	-3	0	1,585.1	196,900	373	1044	946	60.1	7.1	6.1	1.3	5.5	1.5
74	Thu	01/03/08	7:00 AM	969.0	6,749.0	13.0	13.0	NR NB	NR NB	NA NA	33	27	20	17	6	13	16	384	1,889.5	304,400	390		947	70.9	10.8	1.8	7.1	0.0	3.4
	Fri Sat	01/04/08	7:00 AM 10:00 AM	983.0 998.1	6,764.0 6,778.7	14.0 15.1	15.0 14.7	NR NR	NR NR	NA NA	33 33	21	25 25	17 15	12 12	8	16 18	374 398	2,219.1 2,562.0	329,600 342,900	379 384	1047 1049	949 951	81.7 96.0	10.8 14.3	7.3 6.4	3.6	4.5 5.4	1.8 2.1
	Sun	01/06/08	1:00 PM	1,012.7	6,794.0	14.6	15.3	NR	NR	NA	33	26	21	16	7	12	17	392	2,915.5	353,500	394	1052		113.8	17.8	2.0	6.3	1.1	2.8
	Mon Tue	01/07/08	7:00 AM 7:00 AM	1,020.5 1.032.2	6,801.9 6.812.6	7.8 11.7	7.9 10.7	NR NR	NR NR	NA NA	43 32	42 22	39 24	10 17	10	4 8	33 15	196 400	3,112.0 109.4	196,500 NA	417 #VALUE!	1054 1056		128.1 146.4	14.3 18.3	1.0 2.8	2.7 1.8	0.0 4.8	4.3 2.6
	Wed	01/09/08	7:00 AM	1,042.9	6,823.1	10.7	10.5	NR	NR	NA	5	11	9	0	-6	-4	5	0	317.4	208,000	327	1059	961	168.0	21.6	1.8	0.3	2.3	0.6
75	Thu Fri	01/10/08	7:00 AM	1,053.2	6,834.2	10.3 11.0	11.1	NR NB	NR NB	NA NA	29 5	25	25	17	4	-5	12	436	636.3	318,900	497	1062		189.3	21.3	0.9	0.0	0.6	0.1
	Sat	01/11/08	7:00 AM 9:00 AM	1,064.2 1,075.5	6,844.8 6,856.1	11.0	10.6 11.3	NR NR	NR NR	NA NA	31	11 22	10 25	17	-6 9	-5 6	-6 14	425	894.2 1,181.6	257,900 287,400	398 424	1064 1067		206.9 230.7	17.6 23.8	2.3 3.6	0.8	0.8 3.0	0.7
	Sun	01/13/08	9:00 AM	1,085.2	6,865.9	9.7	9.8	NR	NR	NA	30	24	25	18	6	5	12	430	1,443.4	261,800	448	1070		255.2	24.5	1.3	0.6	0.0	0.0

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet (Continued)

																													$\neg \neg$
									KMnO₄					1		Pressure F	iltration								Back	wash	Since L	ast BW	
								KMnO <sub>4</sub>	Tank 2	Estimated											Daily				•	Run	Run		Standby
Week	Day of			Tank A Hour Meter	Tank B Hour Meter	TA Run Time	TB Run Time	Tank 1 Level <sup>(a)</sup>	Level (Iron)	KMnO₄ Dosage	Influent	Outlet	Outlet Tank R	Effluent	Inlet-TA	Inlet-TB	Inlet- Effluent	Flow	Totalizer to	Gallon Usage	Average Flowrate	Tank A	Tank R	Total Volume	Daily Volume	Time Tank ∆	Time Tank B	Time	Time Tank B
No.	Week	Date	Time	hrs	hrs	hrs	hrs	inches	inches	μg/L as Mn	psig	psig	psig	psig	psig	psig	psig	gpm	kgal	gal	gpm	No.	No.	kgal	kgal	hrs	hrs	hrs	hrs
	Mon Tue	01/14/08	7:00 AM 7:00 AM	1,096.3 1.106.9	6,877.1 6.887.5	11.1 10.6	11.2 10.4	NR NR	NR NR	NA NA	31 32	23	25 23	12 17	8 9	6 9	19 15	417 393	1,720.6 1,984.6	277,200 264.000	414 419	1073	978 981	276.0 296.8	20.8	1.7	1.0	0.8 3.5	0.8 3.1
	Wed	01/16/08	7:00 AM	1,117.4	6,898.1	10.5	10.6	NR	NR	NA	30	25	23	17	5	7	13	414	2,252.2	267,600	423	1080	985	325.2	28.4	1.0	0.0	1.5	5.4
76	Thu	01/17/08	7:00 AM 7:00 AM	1,127.7 1.139.3	6,908.9 6,919.8	10.3 11.6	10.8 10.9	NR NR	NR NR	NA NA	30	24	10 22	11 16	6	-5 8	-6 14	394	2,504.4 2,787.6	252,200 283,200	399 420	1082	988 993	342.4 377.3	17.2 34.9	0.0 3.4	1.5 2.7	0.0 4.7	2.3 4.7
	Sat	01/19/08	11:00 AM 12:30 PM	1,151.8 1,164.0	6,931.2 6,943.1	12.5	11.4 11.9	NR NR	NR NR	NA NA	43 19	39	38	30	4	5	13	188	3,077.9	290,300	406 #VALUE!	1089	997 1003	398.1 429.4	20.8	3.8	2.3	2.5	0.6
-	Mon	01/20/08	7:00 AM	1,164.0	6,943.1	12.2 10.7	8.5	NR	NR	NA NA	31	15 24	15 22	18 17	7	9	14	260 406	105.6 323.1	NA 217,500	#VALUE!	1092	1003	429.4 450.2	31.3 20.8	2.8	1.1	0.7 4.9	2.6
	Tue	01/22/08	7:00 AM 7:00 AM	1,192.0 1,201.9	6,966.8 6,975.5	17.3 9.9	15.2 8.7	NR NR	NR NR	NA NA	7 32	11 28	10 29	11 22	-4 4	-3 3	-4 10	710 406	NR 975.0	NA NA	#VALUE! #VALUE!	1096		481.1 516.0	30.9 34.9	5.9 0.8	0.9	3.6 0.0	0.2
77	Thu	01/24/08	7:00 AM	1,215.0	6,983.8	13.1	8.3	NR	NR	NA	40	1	29	15	39	11	25	304	1,277.5	302,500	496	1101	1031	557.3	41.3	0.0	0.3	0.0	0.0
	Fri Sat	01/25/08	7:00 AM 8:00 AM	1,230.3 1,243.6	6,999.6 7.009.3	15.3 13.3	15.8 9.7	NR NR	NR NR	NA NA	42 29	50 24	24 25	14	-8 5	18 4	28 12	180 440	1,660.7 1.980.3	383,200 319.600	411 475	1105	1040	606.2 633.3	48.9 27.1	0.0	1.4 0.3	0.0	0.0
	Sun	01/27/08	8:30 AM	1,258.4	7,022.9	14.8	13.6	NR	NR	NA	8	11	10	12	-3	-2	-4	300	2,300.5	320,200	376	1110	1050	633.8	0.5	3.4	2.1	4.9	3.0
	Mon	01/28/08	7:05 AM 7:10 AM	1,273.6 1.285.6	7,037.2 7,048.1	15.2 12.0	14.3 10.9	NR NR	NR NR	NA NA	29 39	22	23	17 14	7	6 36	12 25	391 299	2,618.2 2,899.9	317,700 281.700	359 411	1112	1054	674.6 695.4	40.8 20.8	3.4 2.6	1.5 0.0	4.3 4.6	0.9
	Wed	01/30/08	7:00 AM	1,304.3	7,065.4	18.7	17.3	NR	NR	NA	32	11	20	12	21	12	20	NR	3,283.8	383,900	356	1115	1060	NR	NA	0.0	5.2	0.0	1.5
78	Thu	01/31/08	7:30 AM 8:00 AM	1,324.9 1.344.4	7,086.1 7.104.9	20.6 19.5	20.7 18.8	NR NR	NR NR	NA NA	23	19 14	14 19	15 14	7	9	8 7	296 273	237.6 522.7	NA 285,100	#VALUE! 248	1117	1063 1065	723.1 733.5	NA 10.4	3.9 8.5	12.1 0.6	1.7 2.8	0.0
	Sat	02/02/08 02/03/08	6:00 AM 12:00 PM	1,362.2 1.386.5	7,122.8 7.147.3	17.8 24.3	17.9 24.5	NR NR	NR NR	NA NA	21 23	17 19	15 14	15 13	4	6	6 10	262 255	783.3 1,143.4	260,600 360,100	243 246	1120 1122	1066	744.2 758.3	10.7 14.1	3.1 2.3	7.1 10.1	2.7	2.7 3.8
-	Mon	02/03/08	7:00 AM	1,401.6	7,147.3	15.1	14.7	NR	NR	NA NA	38	36	33	NR	2	5	NA.	146	1,360.3	216,900	243	1123		765.3	7.0	2.9	11.3	1.8	3.6
	Tue	02/05/08	12:00 PM 7:00 AM	1,422.2 1,436.8	7,181.6 7.196.1	20.6 14.6	19.6 14.5	NR NR	NR NR	NA NA	21 22	16 21	16 14	14 15	5	5 8	7	260 260	1,717.7 1.928.9	357,400 211,200	297 242	1125 1126	1072 1073	782.7 789.7	17.4 7.0	5.2	3.1 8.4	3.2	0.0 3.4
79	Thu	02/07/08	7:00 AM	1,456.2	7,215.5	19.4	19.4	NR	NR	NA	22	19	15	14	3	7	8	270	2,211.6	282,700	243	1127	1074	797.1	7.4	4.8	13.0	2.8	2.8
	Fri Sat	02/08/08	7:30 AM 8:30 AM	1,477.3 1 496.6	7,236.3 7,255.4	21.1 19.3	20.8 19.1	NR NR	NR NR	NA NA	32 23	1 15	19 20	15 15	31 8	13	17 8	201 251	2,520.1 2.800.7	308,500 280.600	245 244	1129		814.0 828.0	16.9 14.0	0.0 7.7	3.9 1.1	0.0 3.1	1.3 0.0
	Sun	02/10/08	8:30 AM	1,515.5	7,275.1	18.9	19.7	NR	NR	NA	25	19	14	15	6	11	10	250	3,079.1	278,400	241	1133	1080	838.6	10.6	3.6	10.1	3.3	3.3
	Mon	02/11/08	7:00 AM 7:00 AM	1,535.6 1,553.8	7,294.6 7,313.1	20.1	19.5 18.5	NR NR	NR NR	NA NA	22	15 15	20 19	15 15	7 9	5	7	253 252	86.9 351.6	NA 264 700	#VALUE!	1134	1082	848.9 856.3	10.3 7.4	9.5 10.9	0.5 3.1	1.8	0.0 3.5
	Wed	05/13/08	7:00 AM	1,572.5	7,332.1	18.7	19.0	NR	NR	NA	23	20	14	15	3	9	8	248	627.0	275,400	244	1137	1084	866.9	10.6	1.3	9.5	0.0	3.6
80	Thu	02/14/08 02/15/08	7:00 AM 7:00 AM	1,591.6 1.610.8	7,351.5 7,370.7	19.1 19.2	19.4 19.2	NR NR	NR NR	NA NA	21 26	16 15	18 17	15 15	5 11	9	6 11	256 238	908.7 1,189.4	281,700 280,700	244 244	1138	1086 1087	877.3 884.2	10.4 6.9	7.0 12.8	7.4	1.5	1.1
	Sat	02/16/08	9:12 AM NR	1,629.6 1,647.4	7,388.6 7,406.3	18.8 17.8	17.9 17.7	NR NR	NR NR	NA NA	21	16 19	18 14	14 15	5 4	3	7	273 250	1,471.1 1,753.4	281,700 282,300	256	1141	1090	901.5 914.3	17.3 12.8	6.7 7.7	0.1	3.5	0.0
-	Sun	02/17/08	7:00 AM	1,666.8	7,406.3	17.8	20.2	NR NR	NR NR	NA NA	23	20	15	15	2	7	7	250	2,035.7	282,300	265 238	1143	1092	914.3	12.8	0.6	8.0	0.0	1.8
	Tue Wed	02/19/08	7:00 AM 7:00 AM	1,684.9 1,702.3	7,444.6 7,461.5	18.1 17.4	18.1 16.9	NR NR	NR NR	NA NA	22 24	20 16	15 17	15 15	2 8	7	7 9	252 241	2,307.3 2,562.6	271,600 255,300	250 248	1147	1095 1097	939.1 949.3	13.8 10.2	0.4 8.3	6.6 5.5	0.0 3.5	3.6
81	Thu	02/21/08	7:00 AM	1,720.2	7,479.4	17.9	17.9	NR	NR	NA	24	16	18	15	8	6	9	236	2,826.2	263,600	245	1150	1099	963.2	13.9	7.5	3.3	3.7	3.7
	Fri Sat	02/22/08	7:00 AM 8:00 AM	1,735.5 1,751.9	7,495.1 7.511.7	15.3 16.4	15.7 16.6	NR NR	NR NR	NA NA	22	16 19	18 15	15 15	6	4 8	7 8	250 253	3,064.1 22.7	237,900 NA	256 #VALUE!	1152 1154	1101	976.7 987.2	13.5 10.5	6.8 2.3	1.6	4.3 8.3	0.5 4.2
	Sun	02/24/08	8:00 AM	1,773.1	7,533.0	21.2	21.3	NR	NR	NA	23	20	15	15	3	8	8	250	327.1	304,400	239	1156	1104	1001.1	13.9	2.0	0.0	9.1	1.7
	Mon Tue	02/25/08	7:30 AM 7:45 AM	1,791.6 1.804.4	7,551.6 7,564.1	18.5 12.8	18.6 12.5	NR 10.0	NR NR	NA NA	28 31	25 24	21 27	18 17	3 7	7	10 14	371 409	648.4 941.8	321,300 293,400	289 387	1161 1166	1109	1035.3 1073.3	34.2 38.0	0.1	1.5 0.0	0.0	0.0
	Wed	02/27/08	7:30 AM	1,816.5	7,576.7	12.1	12.6	9.0	NR	NA	41	4	24	15	37	17	26	242	1,218.2	276,400	373	1169	1116	1094.5	21.2	0.0	2.1	0.0	2.6
82	Thu Fri	02/28/08	7:30 AM 8:00 AM	1,828.4 1,839.5	7,589.4 7,601.3	11.9 11.1	12.7 11.9	NR NR	NR NR	NA NA	31 35	24	26 18	19 15	7 8	5 17	12 20	418 355	1,488.6 1,736.2	270,400 247,600	367 359	1172 1174	1121 1122	1114.5 1125.0	20.0 10.5	1.6 1.5	0.0	0.9	0.0
	Sat	03/01/08 03/02/08	6:00 AM 5:00 AM	1,848.6 1,859.5	7,610.3 7,621.8	9.1 10.9	9.0 11.5	NR NR	NR NR	NA NA	37 36	28 32	23 18	16 15	9	14 18	21 21	380 375	1,934.2 2,122.3	198,000 188,100	365 280	1175 1177	1124 1125	1135.6 1145.1	10.6 9.5	0.0 1.9	2.0 0.6	5.5	5.4 0.3
	Mon	03/02/08	7:00 AM	1,873.6	7,621.6	14.1	14.2	NR	NR	NA NA	31	22	26	17	9	5	14	386	2,122.3	356,900	420	1177		1154.9	9.8	7.2	1.4	5.8	1.7
	Tue	03/04/08	7:00 AM 7:00 AM	1,885.3 1,896.9	7,648.5 7,659.9	11.7	12.5 11.4	NR NR	NR NR	NA NA	33	29	19 28	16 16	4 13	14 5	17 17	366 385	2,738.2 2,980.9	259,000 242,700	357 352	1180	1128	1165.4 1175.5	10.5 10.1	0.5 4.7	5.3	0.0 6.1	6.8
83	Thu	03/06/08	7:00 AM	1,910.4	7,673.1	13.5	13.2	NR	NR	NA	32	22	27	15	10	5	17	401	3,276.3	295,400	369	1183	1132	1188.9	13.4	3.7	0.8	2.4	0.0
	Fri Sat	03/07/08	7:00 AM 10:00 AM	1,920.4 1,931.9	7,682.9 7,694.8	10.0 11.5	9.8 11.9	NR 5.0	NR NR	NA NA	32 38	28 27	20 0	17 15	4 11	12 38	15 23	394 274	207.9 476.2	NA 268,300	#VALUE! 382	1185 1187	1133	1199.4 1213.2	10.5 13.8	0.3 3.1	0.0	4.4 0.0	4.8 0.0
<u> </u>	Sun	03/09/08	10:00 AM	1,946.0	7,708.4	14.1	13.6	2.0	NR	NA	31	20	22	16	11	9	15	360	776.6	300,400	362	1190	1139	1237.2	24.0	6.5	4.3	6.0	8.0
	Mon	03/10/08	7:00 AM 7:10 AM	1,954.2 1,966.2	7,717.3 7,728.4	8.2 12.0	8.9 11.1	2.0 NR	NR NR	NA NA	31 6	23	25 10	17 10	-5	-4	14 -4	400 NR	989.9 1,251.2	213,300 261,300	416 378	1192 1195	1142	1251.3 1268.1	14.1 16.8	2.2 1.0	1.6 2.9	5.1 0.2	2.8 5.5
84	Wed Thu	03/12/08	7:10 AM 7:10 AM	1,977.4 1,988.3	7,739.1	11.2 10.9	10.7 11.2	6.0 12.5	NR NR	NA NA	34 31	22 22	23 27	17 17	12 9	11 4	17 14	365 399	1,508.8 1,768.1	257,600 259.300	392 391	1197 1201	1146	1284.5	16.4 27.1	3.2 1.5	2.4 0.1	5.9 1.7	5.9 0.0
84	Fri	03/13/08	7:10 AM 7:00 AM	1,988.3	7,750.3 7,761.1	10.9	10.8	6.0	NR NR	NA NA	42	52	23	17	-10	19	28	246	2,018.1	259,300	391	1201	1150	1311.6 1334.4	22.8	0.0	2.7	0.0	4.8
	Sat	03/15/08	9:00 AM 9:00 AM	2,010.0 2.020.9	7,772.2 7,783.3	10.9 10.9	11.1	11.3 11.3	NR NR	NA NA	39 32	31 21	0 28	14 17	8	39 4	25 15	305 388	2,293.7	275,600 274,200	418 415	1210 1215	1158	1368.5 1405.5	34.1 37.0	0.4	0.0	0.0	0.0
	Mon	03/17/08	7:00 AM	2,020.9	7,796.8	13.1	13.5	11.3	NR	NA NA	41	1	25	13	40	16	28	252	2,883.3	315,400	395	1220	1169	1441.5	36.0	0.0	1.5	0.0	2.2
	Tue	03/18/08	7:30 AM 8:20 AM	2,047.0 2.059.6	7,810.0 7,822.1	13.0 12.6	13.2 12.1	10.0 8.0	NR NR	NA NA	39 32	31 21	0 27	1 NR	8 11	39 5	38 NA	318 397	3,192.3 NR	309,000 NA	393 #VALUE!	1225 1227	1173	1473.4 1489.6	31.9 16.2	0.5 3.6	0.0	0.0 2.6	0.0
85	Thu	03/20/08	7:10 AM	2,069.0	7,832.0	9.4	9.9	8.0	NR	NA	43	43	40	NR	0	3	NA	152	412.9	NA	#VALUE!	1229	1177	1499.7	10.1	0.6	4.6	0.0	5.7
	Fri Sat	03/21/08	7:00 AM 7:40 AM	2,080.8 2.091.5	7,843.8 7.854.7	11.8 10.7	11.8 10.9	5.0 7.0	NR NR	NA NA	41 36	5 24	24 19	15 16	36 12	17 17	26 20	268 358	674.5 906.7	261,600 232,200	369 358	1230 1232	1179 1180	1510.0 1520.3	10.3	0.0 3.1	3.4 7.9	7.3	6.2 9.4
	Sun	03/23/08	7:10 AM	2,103.6	7,866.8	12.1	12.1	8.0	NR	NA	35	23	20	15	12	15	20	375	1,186.4	279,700	385	1235	1183	1539.8	19.5	2.3	4.2	1.6	2.1
	Mon Tue	03/24/08	7:00 AM 7:00 AM	2,114.9 2,128.2	7,878.0 7,890.2	11.3 13.3	11.2 12.2	NR 8.0	NR NR	NA NA	34 41	20 26	25 59	17 15	14 15	9 -18	17 26	360 270	1,429.2 1,714.1	242,800 284,900	360 373	1236 1239	1185 1187	1550.0 1572.1	10.2 22.1	4.2 2.6	1.4 0.0	7.1 5.0	3.6 0.0
0.5	Wed	03/26/08	7:10 AM	2,139.9	7,902.3	11.7	12.1	10.0	NR	NA	32	28	20	17	4	12	15	377	1,981.1	267,000	374	1242	1190	1589.6	17.5	0.3	3.1	0.0	4.7
86	Thu Fri	03/27/08	7:05 AM 7:00 AM	2,151.0 2,162.3	7,913.3 7,925.3	11.1 11.3	11.0 12.0	10.5 NR	NR NR	NA NA	41 32	25 24	4 23	15 17	16 8	37 9	26 15	267 380	2,229.0 2,488.8	247,900 259,800	374 372	1244 1247	1192 1195	1603.0 1623.9	13.4 20.9	3.3 3.9	0.0 4.7	5.0 5.1	0.0 5.1
	Sat	03/29/08	7:40 AM 7:30 AM	2,172.7 2 184 0	7,935.2 7,947.1	10.4	9.9 11.9	8.0 11.0	NR NR	NA NA	31	23	28	17 10	8 7	3	14	406	2,736.8 2,995.1	248,000 258,300	407 371	1249	1198	1640.9 1653.1	17.0 12.2	2.1	0.0	5.4	0.0 6.2
	oun)	03/30/08	7:30 AM	2,104.0	7,947.1	11.3	11.9	11.0	INIX	INA	4			10	-/	-4	P	U	2,995.1	200,300	3/1	1251	1200	1000.1	12.2	3.1	4.4	1.3	0.2

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet (Continued)

																D										kwash			
									KMnQ.							Pressure F	iltration								Bac	kwash	Since L	ast BW	
								KMnO <sub>4</sub>	Tank 2	Estimated											Daily					Run			Standby
l	l			Tank A Hour		TA Run	TB Run	Tank 1	Level	KMnO₄	l. <u>.</u> .	Outlet	Outlet				Inlet-	Flow	Totalizer to	Gallon	Average	Tank	Tank	Total	Daily	Time	Time	Time	Time
Week No.	Day of Week	Date	Time	Meter hrs	Meter hrs	Time	Time hrs	Level <sup>(a)</sup> inches	(Iron) inches	Dosage µg/L as Mn	Influent	Tank A psig	Tank B psig	Effluent	Inlet-TA psig	Inlet-TB psig	Effluent psig	gpm	Distribution kgal	Usage	Flowrate	A No.	B No.	Volume kgal	Volume kgal	Tank A hrs	Tank B hrs	Tank A hrs	Tank B hrs
	Mon	03/31/08	7:00 AM	2,196.7	7,959.6	12.7	12.5	11.0	NR	NA	42	25	3	14	17	39	28	256	0.8	NA	#VALUE!	1254		1670.9	17.8	2.3	0.0	5.0	0.0
	Tue Wed	04/01/08	7:00 AM 7:00 AM	2,208.1 2,219.5	7,971.2 7,982.5	11.4 11.4	11.6 11.3	NR NR	NR NR	NA NA	42 39	51 30	22 45	16 16	-9 9	-6	26 23	224 368	264.4 521.4	263,600 257,000	382 377	1256 1259	1205 1207	1691.0 1707.3	20.1 16.3	0.0 1.4	3.1 0.0	0.0 1.1	5.9 0.0
87	Thu	04/02/08	7:00 AM	2,219.5	7,992.8	10.4	10.3	NR	NR	NA NA	36	21	21	15	15	15	21	340	750.5	229,100	369	1260	1207	1714.0	6.7	6.9	5.4	7.1	6.3
	Fri Sat	04/04/08	7:10 AM 8:30 AM	2,240.9 2,251.1	8,004.1 8,014.4	11.0 10.2	11.3 10.3	NR NR	NR NR	NA NA	36 38	23	25	16 16	13	11 38	20	381 315	1,000.6 1,240.4	250,100	374 390	1262 1264	1211	1727.2 1737.4	13.2 10.2	5.1	2.4	4.7	4.7 0.0
	Sun	04/05/08	8:30 AM 8:30 AM	2,251.1	8,014.4	11.3	10.3	NR NR	NR NR	NA NA	38	22	0 28	17	9	38	22 14	405	1,240.4	239,800 188.700	292	1264	1212	1737.4	10.2	4.4	1.2	6.5	0.0
	Mon	04/07/08	7:00 AM	2,274.3	8,037.3	11.9	12.6	NR	NR	NA	43	44	41	0	-1	2	43	126	1,758.3	329,200	448	1267		1758.5	10.4	0.6	4.6	0.0	5.8
	Tue Wed	04/08/08	7:00 AM 6:55 AM	2,286.7 2,297.9	8,049.2 8,061.6	12.4 11.2	11.9 12.4	NR NR	NR NR	NA NA	34 34	22	24 26	16 16	12 12	10	18 18	382 378	2,030.7 2,293.1	272,400 262,400	374 372	1268	1217	1769.2 1782.9	10.7	5.2 4.0	2.6 1.9	6.3 5.5	6.3 3.7
88	Thu	04/10/08	7:00 AM	2,309.6	8,074.4	11.7	12.8	NR	NR	NA	31	24	27	17	7	4	14	407	2,566.8	273,700	373	1272		1796.9	14.0	3.0	0.8	5.5	0.6
	Fri Sat	04/11/08	6:55 AM	2,321.4	8,086.9 8,098.3	11.8	12.5	NR NR	NR NR	NA NA	32 36	30 33	20 NR	17 16	2	12 NA	15 20	388 315	2,834.7 3 139 6	267,900 304,900	368 440	1274	1222	1806.9 1818.1	10.0	0.0	6.5	0.0	7.2
	Sun	04/12/08	9:15 AM	2,345.6	8,111.1	12.5	12.8	NR NR	NR	NA NA	4	11	9	5	-7	-5	-1	0	142.0	NA	#VALUE!	1277	1226	1829.8	11.7	4.7	1.7	7.5	1.3
	Mon	04/14/08	7:00 AM	2,356.4	8,122.5	10.8	11.4	NR	NR	NA	31	28	22	18	3	9	13	416	346.0	204,000	307	1279		1839.3	9.5	0.0	4.0	0.0	5.3
	Tue	04/15/08	7:00 AM 7:00 AM	2,368.0	8,133.6 8,146.0	11.6 12.2	11.1 12.4	NR NR	NR NR	NA NA	34 41	20	28 26	18 15	14 40	6 15	16 26	384 269	601.0 880.3	255,000 279,300	375 378	1280 1282	1229	1848.9 1862.6	9.6 13.7	6.1	1.2	1.5	0.9 4.5
89	Thu	04/17/08	7:00 AM	2,394.7	8,159.3	14.5	13.3	NR	NR	NA	5	11	10	10	-6	-5	-5	0	1,198.5	318,200	382	1286	1234	1886.5	23.9	1.1	1.9	0.1	0.1
	Fri Sat	04/18/08	7:00 AM 7:00 AM	2,407.6 2.417.7	8,171.0 8 181.0	12.9 10.1	11.7 10.0	NR 6.0	NR NR	NA NA	32	25 11	24 9	17 9	7 -7	-5	15 -5	394 0	1,488.5 1,715.7	290,000 227,200	394 377	1290	1238	1914.0 1930.6	27.5 16.6	1.0	1.2 0.6	0.0 5.7	0.5 1.2
	Sun	04/19/08	7:40 AM	2,417.7	8,193.2	11.5	12.2	11.0	NR	NA NA	34	25	20	17	9	14	17	375	1,987.0	271,300	382	1295		1947.2	16.6	1.3	3.6	5.5	7.2
	Mon Tue	04/21/08	7:00 AM 7:00 AM	2,444.3 2,457.3	8,207.8 8,220.9	15.1 13.0	14.6 13.1	15.0 NR	NR NR	NA NA	33 35	21 21	28 23	18 16	12 14	5 12	15 19	395 350	2,328.9 2,611.6	341,900 282,700	384 361	1298 1300	1247 1249	1970.7 1984.6	23.5 13.9	2.7 5.6	0.4 3.5	5.3 6.5	0.7 6.5
	Wed	04/22/08	6:55 AM	2,457.3	8,220.9	13.0	13.1	7.0	NR NR	NA NA	35	21	27	16	12	6	19	385	2,611.6	325,200	384	1300	1249	2009.5	24.9	2.8	0.8	5.0	0.8
90	Thu	04/24/08	7:00 AM	2,483.4	8,248.3	12.2	13.1	8.0	NR	NA	39	30	50	15	9	-11	24	296	3,225.3	288,500	381	1306	1254	2061.4	51.9	1.2	0.0	0.9	0.0
	Fri Sat	04/25/08	7:00 AM 8:00 AM	2,495.6 2.507.1	8,259.8 8,271.0	12.2 11.5	11.5 11.2	6.0 5.0	NR NR	NA NA	32 36	22	27 26	17 17	10 16	5 10	15 19	386 372	217.4 473.8	NA 256,400	#VALUE! 377	1308		2080.0 2093.6	18.6 13.6	2.5 3.8	0.5	4.4 7.0	0.0 2.4
	Sun	04/27/08	8:00 AM	2,518.6	8,282.7	11.5	11.7	5.0	NR	NA	4	12	10	10	-8	-6	-6	NR	731.5	257,700	370	1312		2108.2	14.6	3.9	1.4	8.2	4.1
	Mon	04/28/08	7:00 AM 7:00 AM	2,530.3 2.543.9	8,294.5 8.308.3	11.7 13.6	11.8 13.8	5.0 NR	NR NR	NA NA	32 44	23 42	28 44	18 NR	9	4 0	14 NA	401 122	996.1 1,297.2	264,600 301,100	375 366	1314	1263 1265	2127.7	19.5 26.6	3.3	0.1	5.5 4.5	0.0
	Tue Wed	04/29/08	7:00 AM	2,543.9	8,321.6	13.3	13.3	8.0	NR	NA NA	34	24	21	17	10	13	17	363	1,593.4	296,200	371	1319	1267	2182.9	28.6	2.7	3.0	5.0	5.0
91	Thu	05/01/08	7:10 AM	2,570.7	8,335.6	13.5	14.0	10.0	NR	NA	32	28	20	17	4	12	15	390	1,915.6	322,200	391	1323	1271	2211.5	28.6	0.3	2.9	0.0	0.4
	Fri Sat	05/02/08 05/03/08	7:00 AM 8:30 AM	2,584.4 2,595.7	8,348.0 8,354.8	13.7 11.3	12.4 6.8	10.0 4.0	NR NR	NA NA	33 39	21 32	27 0	16 15	12 7	6 39	17 24	382 318	2,228.8 2,469.3	313,200 240,500	401 472	1325 1328	1274 1276	2214.3 2245.8	2.8 31.5	2.7 0.9	0.9	4.4 0.1	0.1
	Sun	05/04/08	8:50 AM	2,607.3	8,370.9	11.6	16.1	9.0	NR	NA	34	27	21	16	7	13	18	386	2,728.6	259,300	320	1330	1278	2260.0	14.2	1.3	4.0	1.5	7.7
	Mon Tue	05/05/08 05/06/08	7:00 AM 7:00 AM	2,618.6 2,630.7	8,381.8 8,393.2	11.3 12.1	10.9 11.4	8.0 8.0	NR NR	NA NA	4 35	11 25	9 21	10 15	-7 10	-5 14	-6 20	367	2,978.6 3,247.1	250,000 268,500	375 381	1332 1333	1280 1282	2274.0 2285.4	14.0 11.4	0.3	3.3	0.6	6.1
	Wed	05/07/08	7:00 AM	2,642.4	8,404.9	11.7	11.7	8.0	NR	NA NA	32	27	21	17	5	11	15	388	242.4	NA	#VALUE!	1336		2313.9	28.5	1.1	3.7	0.0	4.3
92	Thu Fri	05/08/08	7:00 AM 7:00 AM	2,655.6 2,668.9	8,418.3 8,431.6	13.2 13.3	13.4 13.3	8.0 9.0	NR NR	NA NA	32 32	29 23	21 27	18 17	9	11 5	14 15	381 391	556.2 867.5	313,800 311,300	393 390	1340	1288 1291	2353.4 2383.6	39.5 30.2	0.5 3.8	2.6 1.0	0.0 4.0	3.3 0.6
	Sat	05/09/08	7:00 AM	2,682.2	8,444.6	13.3	13.0	10.0	NR	NA NA	34	27	20	16	7	14	18	370	1,153.5	286,000	363	1344	1292	2399.8	16.2	2.3	7.5	4.9	5.8
	Sun	05/11/08	7:00 AM	2,696.7	8,458.4	14.5	13.8	11.0 11.0	NR	NA	35	21	23	16	14	12	19	360	1,466.5	313,000	369	1345		2410.6	10.8	9.6	6.5	4.8	5.4
	Mon Tue	05/12/08 05/13/08	7:00 AM 7:00 AM	2,712.0 2,725.1	8,473.0 8,486.8	15.3 13.1	13.8	11.0 8.0	NR NR	NA NA	34 33	27 29	20 20	16 17	7	14 13	18 16	383 381	1,805.1 2,119.7	338,600 314,600	378 390	1348	1296 1299	2429.3 2461.2	18.7 31.9	1.5 0.2	1.2 2.9	5.8 0.0	4.6 5.0
	Wed	05/14/08	7:10 AM	2,737.0	8,498.8	11.9	12.0	9.0	NR	NA	33	30	19	17	3	14	16	395	2,394.7	275,000	384	1353	1301	2475.8	14.6	0.2	5.7	0.0	5.9
93	Thu Fri	05/15/08	7:40 AM 7:05 AM	2,748.1 2.760.0	8,509.2 8,520.5	11.1	10.4	9.0 8.0	NR NR	NA NA	33 35	26 21	21 24	17 16	7	12 11	16 19	386 354	2,644.1 2.907.0	249,400 262,900	387 378	1354 1355	1303	2486.2 2507.0	10.4 20.8	4.0 7.6	5.0 6.0	5.7 3.5	5.7 4.8
	Sat	05/17/08	NR	2,771.2	8,531.4	11.2	10.9	8.0	NR	NA	34	27	20	16	7	14	18	370	3,180.2	273,200	412	1357	1307	2529.1	22.1	2.3	7.4	4.8	5.6
-	Sun	05/18/08	8:30 AM 7:00 AM	2,782.6 2.794.7	8,543.9 8.556.5	11.4 12.1	12.5 12.6	7.0 9.0	NR NR	NA NA	32 32	25 22	24	17 16	7	8 9	15 16	404 370	165.6 448.8	NA 283,200	#VALUE! 382	1359	1309	2551.7 2565.3	22.6 13.6	4.8 5.3	4.1	5.6 4.3	5.1 4.2
	Tue	05/20/08	6:55 AM	2,804.7	8,567.0	10.0	10.5	8.0	NR	NA	35	22	23	16	13	12	19	347	705.3	256,500	417	1363	1313	2579.5	14.2	4.4	6.6	2.3	6.1
94	Wed	05/21/08	7:00 AM 6:50 AM	2,815.8 2.826.5	8,578.1 8.589.0	11.1 10.7	11.1 10.9	4.0 4.0	NR NR	NA NA	NR 32	NR 31	NR 21	NR 16	NA 1	NA 11	NA 16	NR 390	970.9 1.223.6	265,600 252,700	399 390	1365 1368		2593.7 2610.4	14.2 16.7	4.8 0.0	6.2 0.0	3.7	6.2
94	Fri	05/22/08	7:00 AM	2,836.9	8,599.1	10.7	10.9	7.0	NR	NA NA	35	21	23	16	14	12	19	367	1,461.9	238,300	388	1369	1317	2620.8	10.4	5.1	7.6	3.3	6.7
	Sat	05/24/08	7:45 AM	2,845.8 2,856.9	8,608.0	8.9	8.9	7.0	NR	NA	31	25	27	17 16	6 5	4	14 13	410	1,685.1	223,200 255,500	418	1371	1321	2634.3	13.5	3.4	7.7	1.1	3.5
-	Sun	05/25/08	7:00 AM	2,856.9	8,619.6 8.631.6	11.1 12.6	11.6 12.0	9.0 10.0	NR NR	NA NA	29 30	24 25	25 28	16	5	2	13	433 422	1,940.6 2,229.0	288,400	375 391	1373	1323	2646.9 2660.0	12.6 13.1	1.9 2.1	5.6 4.3	0.5	1.1 0.0
	Tue	05/27/08	7:00 AM	2,882.6	8,644.7	13.1	13.1	10.0	NR	NA	32	23	29	17	9	3	15	408	2,532.2	303,200	386	1377	1327	2673.0	13.0	3.1	0.3	5.5	0.0
95	Wed	05/28/08	6:45 AM 7:00 AM	2,895.5 2,908.5	8,657.5 8,670.5	12.9 13.0	12.8 13.0	7.0 10.0	NR NR	NA NA	30 32	24	28 26	17	6 9	6	13 15	426 403	2,830.5 3,139.4	298,300 308,900	387 396	1380	1330	2692.8 2715.7	19.8 22.9	1.7 2.2	0.0 1.0	2.2 4.6	0.0 1.2
33	Fri	05/30/08	7:10 AM	2,920.6	8,683.2	12.1	12.7	9.0	NR	NA	5	13	10	10	-8	-5	-5	0	155.2	NA	#VALUE!	1385		2725.3	9.6	4.8	2.9	5.6	5.5
	Sat	05/31/08	8:40 AM 8:30 AM	2,932.5 2,945.7	8,695.0 8.706.8	11.9 13.2	11.8 11.8	9.0 8.0	NR NR	NA NA	35 31	22 25	23 21	16 18	13	12 10	19 13	351 396	437.8 719.8	282,600 282.000	397 377	1387	1337	2738.4 2750.9	13.1 12.5	5.2 3.7	5.1	7.2 6.5	7.3 2.1
-	Mon	06/01/08	6:50 AM	2,945.7	8,706.8	11.3	11.8	0.0	NR NR	NA NA	31	25	24	18	10	10	13	383	719.8 993.1	273,300	396	1389	1339	2757.2	6.3	9.0	0.8 8.2	3.9	6.8
	Tue	06/03/08	7:00 AM	2,969.2	8,730.5	12.2	12.0	NR	NR	NA	32	30	21	16	2	11	16	402	1,261.3	268,200	369	1392	1341	2766.8	9.6	0.9	1.5	7.9	8.0
96	Wed Thu	06/04/08	7:15 AM 7:10 AM	2,982.3 2.993.6	8,742.7 8.753.8	13.1 11.3	12.2 11.1	NR 7.0	NR NR	NA NA	31 33	30 24	22 24	17	9	9	14 16	411 398	1,551.0 1.811.1	289,700 260,100	382 387	1394	1343	2779.9 2789.5	13.1 9.6	0.2 5.1	3.8	0.2 6.2	6.1 6.2
55	Fri	06/06/08	7:00 AM	3,005.2	8,766.2	11.6	12.4	33.0	NR	NA	30	25	27	18	5	3	12	412	2,080.7	269,600	375	1397	1347	2802.4	12.9	3.0	0.7	5.2	1.1
	Sat	06/07/08	8:00 AM 8:00 AM	3,016.6	8,779.3 8,791.4	11.4 13.5	13.1 12.1	NR NR	NR NR	NA NA	33 38	25 33	27 0	18 15	- 8 - 5	6 38	15 23	400 318	2,381.1 2,646.7	300,400 265,600	411 347	1399 1401	1349 1350	2814.9 2824.3	12.5 9.4	2.5 1.2	0.7 1.8	4.1 0.0	0.1
	Mon	06/09/08	7:00 AM	3,042.2	8,803.8	12.1	12.1	NR NR	NR	NA NA	32	31	20	16	1	12	16	402	2,046.7	284,100	387	1403		2837.0	12.7	0.2	0.0	6.1	5.0
	Tue	06/10/08	6:50 AM	3,055.8	8,816.0	13.6	12.2	NR	NR	NA	30	30	23	16	0	7	14	422	3,228.2	297,400	385	1404		2849.6	12.6	0.0	0.0	2.2	4.4
97	Wed Thu	06/11/08	6:50 AM 6:55 AM	3,066.1 3,078.3	8,825.8 8,637.9	10.3 12.2	9.8 -187.9	8.0 9.0	NR NR	NA NA	35 38	23 48	23 32	16 15	-10	12 6	19 23	367 312	201.7 493.7	NA 292,000	#VALUE! 187	1406 1408	1357	2862.7 2880.6	13.1 17.9	4.5 0.0	6.5 0.0	3.3 0.6	6.4 0.0
1 -	Fri	06/13/08	7:00 AM	3,090.1	8,850.1	11.8	212.2	NR	NR	NA	41	50	21	15	-9	20	26	248	766.7	273,000	204	1410	1362	2894.7	14.1	0.0	3.5	0.0	5.7
	Sat	06/14/08	9:00 AM 6:30 AM	3,102.7	8,862.1 8,872.6	12.6 10.1	12.0	NR NR	NR NR	NA NA	33	22 10	28 10	17 NR	23	5 23	16 NA	391 NR	1,054.6 1,287.2	287,900	390 377	1412	1365	2907.2 2916.8	12.5 9.6	5.0	1.1 5.6	7.8	0.7 8.8
	Juil	UU/ 10/U0	U.UU MIVI	U, 1 1 Z.O	0,012.0	10.1	10.0	INT\	141/	11//1	JJ	10	10	INL	23	23	IVA	I INT	1,401.4	202,000	511	1414	1300	2010.0	0.0	U.U	J.U	V.7	0.0

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet (Continued)

									KMnO₄					I		Pressure F	iltration								Back	wash	Since La	ast RW	
								KMnO <sub>4</sub>	Tank 2	Estimated											Daily				ŀ	Run			tandby
Week	D			Tank A Hour Meter	Tank B Hour Meter	TA Run	TB Run Time	Tank 1 Level <sup>(a)</sup>	Level (Iron)	KMnO <sub>4</sub> Dosage	Influent	Outlet	Outlet	Effluent	Inlet-TA	Inlet-TB	Inlet- Effluent	Flow	Totalizer to	Gallon	Average Flowrate	Tank A	Tank R	Total Volume	Daily Volume	Time	Time Tank B		Time ank B
No.	Day of Week	Date	Time	hrs	hrs	hrs	hrs	inches	inches	μg/L as Mn	psig	psig	psig	psig	psig	psig	psig	gpm	kgal	Usage gal	gpm	No.	No.	kgal	kgal	hrs	hrs		hrs
	Mon Tue	06/16/08	7:00 AM 8:30 AM	3,124.9 3,141.4	8,884.7 8,900.2	12.1 16.5	12.1 15.5	NR NR	NR NR	NA NA	40 33	28 23	3 26	15 16	12 10	37 7	25 17	283 402	1,564.0 1.935.4	276,800 371.400	381 387	1415 1417	1368	2926.0 2941.6	9.2 15.6	3.6 7.2	6.8 3.7	0.0 3.6	0.0 3.0
	Wed	06/18/08	6:55 AM	3,155.4	8,914.9	14.0	14.7	NR	NR	NA	31	24	27	16	7	4	15	404	2,249.5	314,100	365	1419	1373	2954.5	12.9	3.7	5.5	1.2	1.4
98	Thu	06/19/08 06/20/08	6:50 AM 7:00 AM	3,169.6 3.184.1	8,928.9 8,942.2	14.2 14.5	14.0 13.3	6.0 10.0	NR NR	NA NA	33 41	31 5	26 24	15 15	2 36	7 17	18 26	403 242	2,566.5 2,880.0	317,000 313,500	375 377	1422 1423	1376	2973.7 2983.4	19.2 9.7	0.7	0.0 5.4		3.9 5.6
	Sat	06/21/08	8:30 AM	3,204.9	8,962.2	20.8	20.0	1.0 NR	NR NR	NA	29	17	20	15	12	9	14	250	3,204.5	324,500	265 #VALUE!	1424		2992.5	9.1	20.8	6.8	4.1	3.7
-	Sun	06/22/08 06/23/08	9:00 AM 7:00 AM	3,226.1 3,247.6	8,983.3 9,004.1	21.2 21.5	21.1 20.8	NR	NR	NA NA	41	36 40	35 40	0	5 0	6 0	40	95 105	248.8 557.0	NA 308,200	243	1425	1381 1383	2999.0 3008.5	6.5 9.5	20.4 17.9	2.0	0.0	0.0
	Tue	06/24/08 06/25/08	7:00 AM 7:05 AM	3,262.6 3,276.1	9,019.3 9,032.7	15.0 13.5	15.2 13.4	NR NR	NR NR	NA NA	33 32	22 23	24 28	16 16	11 9	9	17 16	375 393	892.6 1,206.4	335,600 313,800	370 389	1428	1385	3021.6 3037.5	13.1 15.9	0.6 5.1	3.6	4.3	0.0
99	Thu	06/26/08	7:15 AM	3,289.4	9,045.7	13.3	13.0	NR	NR	NA	5	13	10	10	-8	-5	-5	0	1,524.2	317,800	403	1432	1390	3050.2	12.7	2.7	1.4	2.8	1.2
	Fri Sat	06/27/08	7:05 AM 8:00 AM	3,304.5 3.321.2	9,060.1 9.075.7	15.1 16.7	14.4 15.6	9.0 NR	NR NR	NA NA	39 39	55 44	32 44	16	-16 -5	-5	23 39	303 117	1,863.5 2,221.6	339,300 358.100	384 370	1434	1394	3070.1 3084.6	19.9 14.5	0.0 8.2	1.2 4.3		0.0
	Sun	06/29/08	8:00 AM	3,338.2	9,092.1	17.0	16.4	NR	NR	NA	38	33	2	15	5	36	23	312	2,603.9	382,300	382	1439	1399	3100.8	16.2	1.7	1.2	0.0	0.0
	Mon	06/30/08	7:05 AM 7:00 AM	3,353.4 3.372.0	9,107.2 9.125.9	15.2 18.6	15.1 18.7	NR NR	NR NR	NA NA	23	13 22	10 16	10 15	-9 1	-6 7	-6 8	270	2,975.0 3.271.7	371,100 296,700	408 265	1441	1402	3125.7 3137.5	24.9 11.8	1.8 2.9	3.4 11.8		1.2 3.2
	Wed	07/02/08	7:05 AM	3,389.1	9,141.4	17.1	15.5	NR NR	NR	NA	26	16	18	14	10	8	12	238	266.8	NA	#VALUE!	1442	1405	3144.0	6.5	19.9	5.8	9.5	3.1
100	Thu Fri	07/03/08 07/04/08	7:15 AM 7:15 AM	3,408.6 3,427.3	9,161.0 9,179.9	19.5 18.7	19.6 18.9	3.5	NR NR	NA NA	28 33	18 24	18 0	15 15	10 9	10 33	13 18	254 216	560.8 833.0	294,000 272,200	251 241	1443		3152.3 3162.1	8.3 9.8	17.5 3.7	3.5		0.0
	Sat	07/05/08	7:00 AM 7:00 AM	3,442.3 3.461.6	9,194.9 9,214.2	15.0 19.3	15.0 19.3	6.0 NR	NR NR	NA NA	29 24	27 19	26 16	17 NR	2 5	3	12 NA	442 244	1,119.7 1,414.8	286,700 295.100	319 255	1447	1410	3178.3 3184.6	16.2 6.3	1.7 11.3	5.1 3.1		3.4
	Mon	07/07/08	7:15 AM	3,482.5	9,234.5	20.9	20.3	NR	NR	NA	22	18	18	15	4	4	7	258	1,733.1	318,300	258	1449	1413	3194.3	9.7	13.8	2.4	6.4	2.4
	Tue Wed	07/08/08	6:50 AM 7:00 AM	3,504.8 3.528.6	9,257.3 9,280.9	22.3	22.8	NR 6.0	NR NR	NA NA	21 26	22 22	15 14	15 15	-1 4	6 12	6 11	250 239	2,049.1 2.381.9	316,000 332.800	234 234	1451 1452	1414	3204.1 3210.8	9.8 6.7	0.1 5.3	1.8 0.0		0.0 8.0
101	Thu	07/10/08	7:00 AM	3,550.6	9,302.2	22.0	21.3	3.0	NR	NA	25	22	16	15	3	9	10	270	2,688.0	306,100	236	1453	1417	3222.3	11.5	4.3	1.0	11.2	1.0
	Fri Sat	07/11/08	7:00 AM 8:15 AM	3,570.3 3,590.3	9,321.9 9,341.1	19.7 20.0	19.7 19.2	2.0 3.0	NR NR	NA NA	24 41	21 42	15 41	15 0	-1	9	9 41	249 98	2,973.9 3.273.9	285,900 300.000	242 255	1454	1418	3228.9 3238.6	6.6 9.7	5.0 12.0	15.3 2.9		3.2 2.9
	Sun	07/13/08	8:20 AM	3,611.8	9,363.1	21.5	22.0	3.0	NR	NA	45	43	41	0	2	4	45	103	303.8	-2,970,100	-2,276	1456		3245.2	6.6	15.1	8.2	1.6	1.6
	Mon Tue	07/14/08	7:30 AM 7:00 AM	3,632.6 3.654.0	9,383.7 9,405.6	20.8	20.6 21.9	3.0	NR NR	NA NA	46 30	38 28	36 36	0 14	8 2	10 -6	46 16	91 212	608.2 908.7	304,400 300.500	245 231	1457 1460	1422	3251.8 3268.1	6.6 16.3	NR 5.6	11.2 19.6		0.0
400	Wed	07/16/08	6:50 AM	3,676.1	9,428.0	22.1	22.4	3.0	NR	NA	28	24	31	15	4	-3 9	13 17	230	1,181.2	272,500	204	1463	1425	4.1	NA .	3.0	18.6	0.0	0.0
102	Thu Fri	07/17/08 07/18/08	7:00 AM 7:00 AM	3,692.0 3,707.1	9,447.1 9,462.3	15.9 15.1	19.1 15.2	4.0 2.0	NR NR	NA NA	32 22	21 22	23 14	15 14	0	8	8	403 270	1,513.0 1,815.8	331,800 302,800	319 333	1469 1472	1428 1431	33.2 51.8	29.1 18.6	2.5 1.0	1.6 6.1		3.3
	Sat	07/19/08	11:00 AM 10:00 AM	3,731.1 3,753.0	9,485.7 9,507.6	24.0	23.4	3.0 3.0	NR NR	NA NA	22	17 18	20 20	16 17	5	2	6	264 275	2,161.1 2 474 6	345,300 313,500	243 239	1473	1433	61.5 68.0	9.7 6.5	9.7 13.0	1.9		0.0
	Mon	07/21/08	6:55 AM	3,773.0	9,527.7	20.0	20.1	3.0	NR	NA	25	17	19	15	8	6	10	261	2,779.4	304,800	253	1475	1435	74.6	6.6	14.2	6.5	0.0	0.0
	Tue	07/22/08	7:05 AM 7:10 AM	3,796.2 3,817.2	9,550.0 9,570.5	23.2 21.0	22.3 20.5	3.0 3.0	NR NR	NA NA	22 25	17 18	20 18	15 15	5 7	2	7 10	262 265	3,112.1 141.1	332,700 NA	244 #VALUE!	1476	1437 1438	84.4 90.7	9.8 6.3	13.3 14.0	1.8 6.6		2.6
103	Thu	07/24/08	7:00 AM	3,839.1	9,593.4	21.9	22.9	4.0	NR	NA	22	22	14	15	0	8	7	247	468.9	327,800	244	1479	1439	100.3	9.6	1.8	13.6	0.0	0.0
	Fri Sat	07/25/08	7:10 AM 8:00 AM	3,862.8 3.878.3	9,616.5 9.632.2	23.7 15.5	23.1 15.7	3.0 3.0	NR NR	NA NA	20 39	18 51	19 26	15 13	-12	1 13	5 26	262 288	810.0 1.201.5	341,100 391.500	243 418	1480	1441 1446	110.0 141.4	9.7 31.4	8.0 0.0	1.5		1.4
	Sun	07/27/08	8:00 AM	3,891.3	9,644.5	13.0	12.3	3.0	NR	NA	27	27	23	16	0	4	11	449	1,527.6	326,100	430	1488	1451	167.2	25.8	0.2	1.0	0.0	0.0
	Mon Tue	07/28/08	7:00 AM 7:15 AM	3,904.4 3,918.0	9,656.6 9,670.1	13.1 13.6	12.1 13.5	3.0 5.0	NR NR	NA NA	28 5	25 12	26 10	16 10	-7	-5	-5	156 0	1,855.2 2,190.6	327,600 335,400	434 413	1490 1495		185.6 220.4	18.4 34.8	1.7 0.4	1.0		0.0
104	Wed Thu	07/30/08 07/31/08	7:05 AM 7:10 AM	3,932.6 3,946.3	9,683.7 9,697.2	14.6 13.7	13.6 13.5	3.0 4.0	NR NR	NA NA	7 29	13 24	10 24	10 15	-6 5	-3 5	-3 14	0 405	2,535.4 2,873.3	344,800 337,900	408 414	1497 1500	1464 1467	235.9 254.4	15.5 18.5	2.6 2.2	0.6 1.5	2.4	0.0
104	Fri	08/01/08	7:20 AM	3,958.7	9,709.5	12.4	12.3	3.0	NR	NA	7	13	10	10	-6	-3	-3	0	3,181.0	307,700	415	1503	1471	275.4	21.0	1.3	0.7	0.0	0.0
	Sat	08/02/08 08/03/08	10:00 AM	3,972.0 3,984.1	9,722.0 9,733.5	13.3 12.1	12.5 11.5	4.0 4.0	NR NR	NA NA	6 30	13 22	10 26	10 15	-7 8	-4 4	-4 15	0 407	232.1 514.3	NA 282,200	#VALUE! 399	1505	1474	290.6 305.8	15.2 15.2	3.3	1.9		0.0
	Mon	08/04/08	7:00	3,995.4	9,744.5	11.3	11.0	3.0	NR	NA	30	24	25	16	6	5	14	411	777.1	262,800	393	1509	1479	318.0	12.2	3.2	0.9	5.9	1.9
	Tue Wed	08/05/08 08/06/08	7:30 AM 6:55 AM	4,005.4 4,015.7	9,755.2 9,765.4	10.0	10.7 10.2	0.0	NR NR	NA NA	32	10 24	23	15	-7 8	-4 9	-4 17	0 381	1,024.7 1,284.0	247,600 259,300	399 422	1511 1513	1481	330.0 342.2	12.0 12.2	4.1	3.4		7.3 7.1
105	Thu	08/07/08 08/08/08	7:05 AM 6:50 AM	4,029.7 4.043.6	9,778.8 9,792.4	14.0 13.9	13.4 13.6	0.0 NR	NR NR	NA NA	39 30	6 29	26 21	14 15	33 1	13 q	25 15	287 402	1,604.6 1,928.9	320,600 324,300	390 393	1515 1518	1486 1489	357.1 375.3	14.9 18.2	0.0	0.0 2.0		5.0 3.8
	Sat	08/09/08	6:45 AM	4,057.1	9,804.6	13.5	12.2	NR	NR	NA	29	28	24	15	1	5	14	396	2,227.9	299,000	389	1520	1492	391.1	15.8	0.5	1.1	1.0	2.9
-	Sun	08/10/08	7:30 AM 6:55 AM	4,071.5 4,085.4	9,818.5 9,832.2	14.4 13.9	13.9 13.7	NR NR	NR NR	NA NA	28 28	28 28	23 23	16 15	0	5 5	12 13	408 401	2,550.8 2,859.7	322,900 308,900	380 373	1522	1495 1499	406.1 421.4	15.0 15.3	0.1	1.4		1.3
	Tue	08/12/08	7:00 AM	4,099.3	9,845.8	13.9	13.6	NR	NR	NA	28	28	24	17	0	4	11	409	3,158.1	298,400	362	1526	1501	436.8	15.4	0.1	1.1	0.0	0.7
106	Wed	08/13/08 08/14/08	7:00 AM 6:50 AM	4,111.3 4,123.6	9,857.7 9,870.2	12.0 12.3	11.9 12.5	NR NR	NR NR	NA NA	40 32	3 22	26 25	14 15	37 10	14 7	26 17	280 375	154.1 437.6	-3,004,000 283,500	-4,190 381	1527 1529	1503 1506	445.7 460.7	8.9 15.0	0.0 5.0	2.5		5.1 2.8
100	Fri	08/15/08	6:50 AM	4,136.8	9,882.7	13.2	12.5	NR	NR	NA	32	16	21	15	16	11	17	321	733.1	295,500	384	1531	1509	475.5	14.8	0.0	0.3	0.0	0.0
	Sat	08/16/08	7:50 AM 7:00 AM	4,155.5 4.176.9	9,901.5 9.922.6	18.7 21.4	18.8 21.1	NR NR	NR NR	NA NA	23 30	18 6	20	15 15	5 24	3 10	8 15	266 220	1,025.7 1.338.1	292,600 312.400	260 245	1533 1534		488.1 496.8	12.6 8.7	6.8	1.9 5.0		0.5 1.2
	Mon	08/18/08	7:10 AM	4,200.0	9,945.1	23.1	22.5	NR	NR	NA	22	17	18	15	5	4	7	248	166.8	-1,171,300	-856	1536	1515	524.4	27.6	8.5	3.3	0.0	0.0
	Tue Wed	08/19/08 08/20/08	7:00 AM 7:00 AM	4,219.6 4,238.9	9,963.8 9,983.2	19.6 19.3	18.7 19.4	NR NR	NR NR	NA NA	29 26	24	26 15	16 15	5 6	3 11	13 11	412 244	2,017.2 2,312.5	1,850,400 295,300	1,611 254	1538 1539	1518 1519	565.8 581.9	41.4 16.1	2.9 6.6	0.6 12.6		0.6 2.8
107	Thu Fri	08/21/08 08/22/08	7:00 AM 7:10 AM	4,259.0 4,278.8	10,002.4 10.022.0	20.1 19.8	19.2 19.6	NR 0.0	NR NR	NA NA	23 30	18 22	19 48	15 15	5 8	-18	8 15	260 398	2,597.2 2.880.6	284,700 283,400	242 240	1540 1541	1521 1522	606.7 624.6	24.8 17.9	10.6 8.0	4.6 0.0	1.4	1.4 0.0
	Sat	08/23/08	9:50 AM	4,294.8	10,037.4	16.0	15.4	NR	NR	NA	42	44	43	17	-2	-1	25	173	3,219.8	339,200	360	1544	1526	681.6	57.0	2.6	1.2	0.0	0.0
-	Sun	08/24/08	8:30 AM 7:00 AM	4,309.4 4.322.7	10,051.7	14.6 13.3	14.3 13.2	NR NR	NR NR	NA NA	42 30	43 25	39 25	NR 16	-1 5	3 5	NA 14	159 398	259.3 566.4	NA 307.100	#VALUE! 386	1546 1548	1528 1531	715.5 756.7	33.9 41.2	2.0	3.1		3.9 0.6
	Tue	08/26/08	7:00 AM	4,337.9	10,079.4	15.2	14.5	NR	NR	NA	31	23	26	16	8	5	15	384	893.6	327,200	367	1550	1534	798.1	41.4	3.2	1.4	3.7	0.6
108	Wed	08/27/08 08/28/08	7:00 AM 7:00 AM	4,354.5 4,369.4	10,096.4 10,110.8	16.6 14.9	17.0 14.4	NR NR	NR NR	NA NA	29 44	27 44	24 42	16 0	0	5	13 44	415 128	1,267.3 1,586.9	373,700 319,600	371 364	1553 1555	1537 1540	847.6 889.5	49.5 41.9	0.9 2.8	2.2		0.5 2.1
	Fri	08/29/08	NR	NR	NR	NA	NA	NR	NR	NA	NR	NR	NR	NR	NA	NA	NA	NR	NR	NA	#VALUE!	NR	NR	NR	NA	NR	NR	NR	NR
	Sat	08/30/08	11:30 AM 8:00 AM	4,402.4 4.415.1	10,141.4 10,158.5	NA 12.7	NA 17.1	NR NR	NR NR	NA NA	43 7	18 15	13	12 10	25 -8	-6	-31 -3	165	2,283.0 2.309.3	NA NA	#VALUE!	1574 1584	1566 1567	958.6 958.6	0.0	0.0 12.2	17.2	6.2	6.2

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet (Continued)

										KMnO₄					1		Pressure f	Filtration								Back	wash	Since I	ast BW	
									KMnO <sub>4</sub>	Tank 2	Estimated											Daily					Run		Standby	Standby
l	1_				Tank A Hour	Tank B Hour	TA Run	TB Run	Tank 1	Level	KMnO₄		Outlet	Outlet				Inlet-	Flow	Totalizer to	Gallon	Average	Tank	Tank	Total	Daily	Time	Time	Time	Time
Week No.		ay of Neek	Date	Time	Meter hrs	Meter hrs	Time hrs	Time hrs	inches	(Iron) inches	Dosage µg/L as Mn	Influent	Tank A psig	Tank B psig	Effluent	Inlet-TA psig	Inlet-TB psig	Effluent psig	gpm	Distribution kgal	Usage gal	Flowrate	No.	No.	Volume kgal	Volume kgal	Tank A hrs	Tank B hrs	Tank A hrs	Tank B hrs
		Mon	09/01/08	NR	NR	NR	NA	NA	NR	NR	NA	NR	NR	NR	NR	NA	NA	NA	NR	NR	NA	#VALUE!	NR		NR	NA	NR	NR	NR	NR
		Tue Wed	09/02/08	NR NR	NR NR	NR NR	NA NA	NA NA	NR NR	NR NR	NA NA	NR NR	NR NR	NR NR	NR NR	NA NA	NA NA	NA NA	NR NR	NR NR	NA NA	#VALUE! #VALUE!	NR NR	NR NR	NR NR	NA NA	NR NR	NR NR	NR NR	NR NR
109		Thu	09/04/08	1:30 AM	4,426.9	10,165.3	NA NA	NA	NR	NR	NA	5	10	17	10	-5	-12	-5	0	2,310.1	NA NA	#VALUE!	1584	1567	958.6	NA	0.0	0.0	0.0	0.0
		Fri Sat	09/05/08	7:00 AM 5:30 AM	4,426.9 4.439.5	10,165.3 10.175.0	12.6	9.7	NR NR	NR NR	NA NA	13 38	16	10	15	5 22	3 25	-2 25	0	2,310.1 2,620.6	0 310.500	#DIV/0! 472	1584 1593	1567 1583	958.6 1042.5	0.0 83.9	0.0	0.0	0.0	0.0
		Sun	09/07/08	8:00 AM	4,439.5	10,175.2	0.0	0.2	NR	NR	NA	20	24	22	23	-4	-2	-3	0	2,629.8	9,200	#DIV/0!	1594	1584	1049.0	6.5	0.4	0.0	0.0	0.0
		Mon Tue	09/08/08	NR 7:00 AM	4,439.5 4 451.0	10,175.2 10,186.4	0.0 11.5	0.0	NR NR	NR NR	NA NA	19 31	23 25	21	NR NR	-4 6	-2 10	NA NA	380	2,629.8 2,905.6	NA 275.800	#VALUE! 405	1594	1584 1585	1049.0 1060.7	0.0 11.7	0.4 8.9	9.1	0.0 8.9	0.0 8.4
		Wed	09/09/08	7:00 AM	4,451.0	10,186.4	13.1	12.2	NR	NR	NA NA	32	25	22	NR	7	10	NA NA	375	3,189.7	284,100	375		1585	1060.7	0.0	22.0	10.0	18.2	10.0
110		Thu Fri	09/11/08	6:00 AM	4,477.4 4 489 1	10,211.2	13.3	12.6 11.7	NR NR	NR NR	NA NA	5 31	13	10	NR	-8 7	-5 5	NA	0 386	206.7	NA 281.700	#VALUE!	1596	1587	1071.3	10.6 7.1	12.8 10.1	0.7 2.7	8.5	0.1
		Sat	09/12/08	6:55 AM 9:00 AM	4,489.1	10,222.9 10,236.0	11.7	11.7	NR NR	NR NR	NA NA	31	24	26 25	NR NR	8	7	NA NA	389	488.4 794.7	306,300	401 383	1597	1588 1589	1078.4 1085.9	7.1	10.1	6.2	9.4 8.7	4.4 6.8
		Sun	09/14/08	9:00 AM	4,516.0	10,249.4	13.3	13.4	NR	NR	NA	4	13	11	NR	-9	-7	NA	0	1,093.4	298,700	373	1599	1590	1093.1	7.2	10.9	7.4	9.3	8.7
		Mon Tue	09/15/08	6:45 AM 6:45 AM	4,528.5 4.541.0	10,261.6 10.273.9	12.5 12.5	12.2 12.3	NR NR	NR NR	NA NA	33	25 13	23 10	16	-9	-6	17 -7	364 0	1,375.6 1.659.9	282,200 284,300	381 382		1591 1593	1100.2 1110.7	7.1 10.5	11.2 9.4	8.8 2.6	7.8 9.1	7.8 5.5
	١	Wed	09/17/08	6:40 AM	4,553.5	10,286.3	12.5	12.4	NR	NR	NA	32	25	25	16	7	7	16	380	1,942.0	282,100	378	1602	1594	1117.9	7.2	10.7	4.7	9.1	6.0
111		Thu Fri	09/18/08	6:55 AM 6:55 AM	4,566.5 4.579.1	10,299.1 10.311.4	13.0 12.6	12.8 12.3	NR NR	NR NR	NA NA	33 29	23 28	24 24	16 17	10	9	17 12	378 420	2,229.8 2.519.0	287,800 289,200	372 387	1603 1605	1595 1597	1125.0 1139.3	7.1 14.3	11.7 1.7	6.6 3.8	9.7 2.1	5.4 4.8
		Sat	09/20/08	8:30 AM	4,591.6	10,324.5	12.5	13.1	NR	NR	NA	29	26	26	17	3	3	12	430	2,805.0	286,000	373	1606	1599	1149.9	10.6	3.7	0.1	4.7	0.0
		Sun	09/21/08	8:30 AM 6:55 AM	4,604.6 4.617.6	10,336.7 10,349.3	13.0 13.0	12.2 12.6	NR NR	NR NR	NA NA	30 30	25 24	25 27	17	5	5	13 13	400 392	3,208.1 127.7	403,100 NA	534 #VALUE!		1600 1062	1157.0 1167.5	7.1 10.5	6.9 8.2	4.1 2.1	6.7 5.8	4.0 1.9
		Tue	09/22/08	6:55 AM	4,630.3	10,349.3	13.0	12.6	NR NR	NR NR	NA NA	29	26	25	16	3	4	13	402	127.7 429.1	301,400	#VALUE! 400		1604		10.5	4.6	2.5	3.9	0.0
112		Wed Thu	09/24/08	6:55 AM 7:00 AM	4,644.7 4,658.1	10,375.9 10,388.7	14.4 13.4	14.2 12.8	NR NR	NR NR	NA NA	29 28	27 28	23 25	16 17	2	6	13	407 442	764.7 1,077.9	335,600 313,200	391 399	1612	1606 1609	1195.5 1213.1	13.6 17.6	2.1 0.0	5.3 1.1	1.4 0.0	3.3 0.6
112		Fri	09/25/08	6:55 AM	4,658.1	10,388.7	13.4	12.8	NR NR	NR NR	NA NA	28 4	12	10	10	-8	-6	-6	0	1,077.9	279,100	399		1611	1213.1	17.6	5.1	3.1	6.5	6.0
		Sat	09/27/08	8:00 AM	4,682.0	10,413.0	11.0	12.5	NR	NR	NA	31	22	26	18	9	5	13	408	1,661.6	304,600	434	1617		1241.0	17.3	5.2	1.6	7.0	1.8
-		Sun Mon	09/28/08 09/29/08	8:10 AM 7:05 AM	4,696.4 4,711.6	10,426.9 10,442.1	14.4 15.2	13.9 15.2	NR NR	NR NR	NA NA	5 30	11 23	10 26	10	-6 7	-5 4	-5 13	410	1,984.0 2,331.8	322,400 347,800	380 381	1619	1616 1618	1255.4 1270.0	14.4 14.6	6.3 4.6	2.0 0.5	5.9 4.3	2.8 0.0
		Tue	09/30/08	6:55 AM	4,724.7	10,455.6	13.1	13.5	NR	NR	NA	30	27	23	18	3	7	12	418	2,636.4	304,600	382	1623	1619	1280.9	5.4	0.2	0.5	0.0	5.4
440		Wed	10/01/08	6:50 AM	4,738.5	10,469.0	13.8	13.4	NR	NR	NA	31	23	26	16	- 8 - 5	5 9	15	409	2,946.1	309,700	380	1624		1291.5	10.6	5.4	1.4	4.5	0.7
113		Thu Fri	10/02/08	7:05 AM 7:00 AM	4,751.5 4,766.8	10,482.6 10,497.8	13.0 15.3	13.6 15.2	NR NR	NR NR	NA NA	30 39	25 28	21 36	18 15	11	3	12 24	408 274	3,248.0 302.5	301,900 302,500	379 331	1626 1629	1622 1625	1302.4 1326.2	10.9 23.8	2.4	6.7 0.0	4.2 2.8	5.2 0.0
		Sat	10/04/08	8:30 AM	4,785.2	10,516.4	18.4	18.6	NR	NR	NA	29	25	20	13	4	9	16	366	661.0	358,500	323	1632	1628	1344.9	18.7	1.9	6.8	0.2	4.3
-		Sun Mon	10/05/08	8:00 AM 7:00 AM	4,804.0 4,824.3	10,535.2 10,555.1	18.8 20.3	18.8 19.9	NR NR	NR NR	NA NA	29 31	26	20	16 16	3 11	9	13 15	374 355	992.6 1.341.6	331,600 349,000	294 289		1630 1632	1358.8 1369.4	13.9 10.6	1.3	7.6 6.3	0.0 1.9	3.8
	_	Tue	10/07/08	NR	4,834.2	10,564.8	9.9	9.7	NR	NR	NA	39	18	17	16	21	22	23	173	1,520.2	178,600	304		1633	1376.9	7.5	0.6	6.1	0.0	7.5
l		Wed	10/08/08	6:50 AM	4,845.7	10,576.2	11.5	11.4	19.0	NR	NA	27	27	23	17	0	4	10	373	1,756.1	235,900	343		1634	1384.4	7.5	0.8	4.1	0.5	4.9
114		Thu Fri	10/09/08	NR NR	4,862.4 4,882.0	10,592.7 10,612.3	16.7 19.6	16.5 19.6	29.0 NR	NR NR	NA NA	29 28	23 18	21 14	16 15	6 10	14	13 13	373 239	2,088.2	332,100 350.400	333 298	1639 1641		1402.7 1417.0	18.3 14.3	5.6 1.8	6.9 9.0	4.1 0.7	4.1 1.9
		Sat	10/11/08	NR	4,899.9	10,629.6	17.9	17.3	NR	NR	NA	31	23	24	16	8	7	15	381	2,811.2	372,600	353		1641	1428.3	11.3	8.9	5.2	5.2	5.2
-		Sun Mon	10/12/08	NR 7:00 AM	4,914.0 4,929.9	10,643.7 10,659.4	14.1 15.9	14.1 15.7	NR NR	NR NR	NA NA	32 30	23 25	22 23	NR 17	9	10	NA 13	370 395	3,131.1 211.4	319,900 211,400	378 223	1643 1645	1642 1644	1435.1 1449.5	6.8 14.4	11.1 5.0	8.0 6.9	7.2 4.9	6.6 4.9
		Tue	10/13/08	7:05 AM	4,952.3	10,681.3	22.4	21.9	NR	NR	NA NA	20	22	16	15	-2	4	5	252	530.1	318,700	240		1646	1463.5	14.0	0.0	10.0	0.0	0.0
		Wed	10/15/08	7:00 AM	4,969.3	10,698.0	17.0	16.7	21.0	24.0		30	27	22	17	3	8	13	396	871.5	341,400	338		1647	1470.7	7.2	3.9	7.9	2.2	3.2
115		Thu Fri	10/16/08	7:00 AM 6:55 AM	4,984.9 4,996.7	10,713.5 10.725.2	15.6 11.8	15.5 11.7	25.0 NR	33.0 NR	NA	32 31	27 30	20 20	15 16	5	12	17 15	369 398	1,201.4 1,440.8	329,900 239,400	354 340	1649 1650		1477.5 1484.7	6.8 7.2	4.3 0.1	11.5 11.4	4.8 0.0	5.2 10.8
		Sat	10/18/08	6:45 AM	5,013.7	10,741.8	17.0	16.6	NR	NR	NA	32	29	22	17	3	10	15	389	1,799.8	359,000	356	1651	1650	1492.3	7.6	2.3	3.2	3.0	5.9
		Sun Mon	10/19/08	8:00 AM 7:00 AM	5,033.6 5,052.3	10,761.2 10,780.4	19.9 18.7	19.4 19.2	32.0 NR	10.0 NR	NA NA	35 42	21 5	28	17	14 37	7	18 27	365 245	2,210.5 2,608.5	410,700 398,000	348 350	1652 1654	1652 1653	1502.9 1513.9	10.6 11.0	10.1	3.2 8.4	3.9	1.6
	_	Tue	10/21/08	7:00 AM	5,052.3	10,780.4	17.9	17.7	4.0	NR	NA NA	35	24	26	16	11	9	19	359	3,005.1	396,600	371	1656		1513.9	14.4	9.0	7.6	3.2	3.2
		Wed	10/22/08	7:00 AM	5,088.2	10,816.3	18.0	18.2	13.0	3.0		42	38	1	15	4	41	27	263	147.2	147,200	136		1658		25.0	1.0	0.0	0.0	0.0
116		Thu Fri	10/23/08	7:00 AM 6:50 AM	5,105.6 5.125.0	10,833.3 10,852.5	17.4 19.4	17.0 19.2	14.0 15.0	13.0 32.0		35 34	27	29	16 17	7	6	19 17	360 352	518.9 901.2	371,700 382,300	360 330	1662	1661 1664	1571.1 1593.0	17.8 21.9	5.7 5.7	3.4 2.8	3.4 0.9	2.6
1		Sat	10/25/08	7:30 AM	5,145.8	10,873.4	20.8	20.9	NR	NR	NA	43	37	40	14	6	3	29	227	1,318.1	416,900	333	1668	1666	1611.9	18.9	3.8	0.0	0.6	0.0
		Sun	10/26/08	7:30 AM	5,168.0	10,895.7	22.2	22.3	NR 45.0	NR	NA	45	46	44	15	-1 5	1 4	30	85	1,773.2	455,100	341		1669	1632.0	20.1	3.0	6.2	1.3	1.4
		Mon Tue	10/27/08	7:00 AM 6:50 AM	5,189.1 5.211.5	10,916.5 10.939.2	21.1	20.8	15.0 15.0	NR NR	NA NA	27 32	22 30	23 25	20	2	7	12	180 292	2,071.9 2.451.7	298,700 379,800	238 281	1675	1671 1673	1642.9 1660.6	10.9 17.7	16.4 0.4	11.5	0.9	0.9
		Wed	10/29/08	7:00 AM	5,227.6	10,955.5	16.1	16.3	15.0	NR	NA	36	32	32	18	4	4	18	332	2,766.4	314,700	324	1677		1675.0	14.4	1.5	3.7	1.1	5.4
117		Thu Fri	10/30/08	7:00 AM 7:00 AM	5,240.8 5.253.5	10,969.1 10.981.3	13.2 12.7	13.6 12.2	15.0 15.0	NR NR	NA NA	37 37	32 29	28 34	16 16	5 8	9	21	338 352	3,028.3 3.272.5	261,900 244,200	326 327	1679	1676 1678	1686.0 1696.6	11.0 10.6	2.7 6.8	8.6 0.9	4.4 6.0	7.9 0.0
1		Sat	11/01/08	7:00 AM	5,253.5	10,981.3	11.0	10.6	15.0	NR	NA	5	10	10	10	-5	-5	-5	0	202.4	202,400	312	1681	1679	1703.5	6.9	8.9	1.5	9.5	5.3
		Sun	11/02/08	8:00 AM	5,279.0	11,006.4	14.5	14.5	15.0	NR	NA NA	37	31	30	16	6	7	21	330	483.0	280,600	323	1683		1714.4	10.9	5.3	7.0	6.4	7.1
	_	Mon Tue	11/03/08	7:30 AM 6:55 AM	5,291.3 5.303.6	11,018.7 11,030.9	12.3 12.3	12.3 12.2	NR NR	NR NR	NA NA	35 37	33 30	33 32	16 17	7	5	19 20	350 333	716.9 964.6	233,900 247,700	317 337	1685 1686	1682 1683	1728.8 1736.0	14.4 7.2	0.8 5.8	0.4 4.1	0.0 6.3	0.0 6.3
1	١	Wed	11/05/08	6:55 AM	5,316.4	11,043.7	12.8	12.8	NR	NR	NA	36	32	34	17	4	2	19	341	1,211.0	246,400	321	1688	1685	1750.1	14.1	2.6	0.2	4.4	0.0
118		Thu Fri	11/06/08	6:50 AM 8:00 AM	5,328.1	11,055.4 11,067.2	11.7 NA	11.7 11.8	NR NR	NR NR	NA NA	27 6	29 11	32 9	16	-2 -5	-5 -3	11	343	1,431.3 1,659.1	220,300 227.800	314 #VALUE!	1689 1691	1686 1687	1757.3 1767.9	7.2 10.6	6.4 4.7	3.8 7.8	7.6 7.0	6.9 7.0
1	_	Sat	11/07/08	8:00 AM NR	4,340.2 NR	11,067.2 NR	NA NA	11.8 NA	NR NR	NR NR	NA NA	37	31	30	10	-5 6	-3 7	21	334	1,659.1 1,869.4	210,300	#VALUE!		1687	17.0	-1750.9	4./ 5.2	7.8	7.0 6.2	7.0
<u></u>		Sun	11/09/08	8:00 AM	5,361.6	11,088.8	NA	NA	NR	NR	NA	34	27	30	17	7	4	17	352	2,087.1	217,700	#VALUE!	1694	1690	1788.8	1771.8	4.4	6.6	7.9	8.0
	_	Mon Tue	11/10/08	7:00 AM 8:15 AM	5,373.5 5,390.3	11,100.5 11,117,7	11.9 16.8	11.7 17.2	NR NR	NR NR	NA NA	36 NR	32 NR	30 NR	16 NR	4 NA	6 NA	20 NA	350 NR	2,389.9 2 608.9	302,800 219,000	428 215	1696 1699		1802.4 1819.9	13.6 17.5	2.0	4.3	3.8	5.2 0.0
	١	Wed	11/12/08	7:00 AM	5,405.4	11,132.3	15.1	14.6	NR	NR	NA	36	33	34	16	3	2	20	315	2,887.6	278,700	313	1701	1697	1839.0	19.1	5.1	2.4	4.7	1.7
119		Thu	11/13/08	7:00 AM	5,419.8	11,146.7	14.4	14.4	NR	NR	NA NA	38	29	31	16	9	7	22	311	3,148.2	260,600	302	1702		1845.2	6.2	8.0	6.2	6.3	5.7
		Fri Sat	11/14/08	7:00 AM 7:00 AM	5,434.2 5.447.1	11,160.7 11.173.5	14.4	14.0 12.8	NR NR	NR NR	NA NA	37	12 31	11 30	10	-4 6	-3 7	-2 21	315	135.8 377.3	135,800 241,500	159 313	1704 1705	1700	1859.6 1866.8	14.4 7.2	4.2 7.0	1.9 6.0	4.5 7.4	1.1 7.4
		Sun	11/16/08	8:00 AM	5,463.2	11,189.8	16.1	16.3	NR	NR	NA NA	6	11	9	0	-5	-3	6	0	683.0	305,700	315		1703	1881.9	15.1	3.8	4.7	3.8	3.8

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet (Continued)

									KMnO <sub>4</sub>				l			Pressure	Filtration						1	Bac	kwash	Since L	ast BW	
								KMnO <sub>4</sub>	Tank 2	Estimated											Daily				Run			Standby
Week	Day of			Tank A Hour	Tank B Hour	TA Run	TB Run	Tank 1	Level (Iron)	KMnO <sub>4</sub>	Influent	Outlet	Outlet	Effluent	Inlet-TA	Inlet-TB	Inlet-	Flow	Totalizer to	Gallon Usage	Average Flowrate	Tank Tank	Total Volume	Daily Volume	Time	Time Tank B	Time	Time Tank B
No.	Day of Week	Date	Time	hrs	hrs	hrs	hrs	inches	inches	Dosage μg/L as Mn	psig	gpm	kgal	gal	gpm	No. No.	kgal	kgal	hrs	hrs	hrs	hrs						
	Mon Tue	11/17/08	7:00 AM 7:30 AM	5,477.8 5.496.6	11,203.8 11,222.7	14.6 18.8	14.0 18.9	NR NR	NR NR	NA NA	36 46	31 45	33 44	17 0	5	3	19 46	334 70	947.6 1,298.3	264,600 350,700	309 310	1708 1705 1710 1707	1892.9 1906.9	11.0 14.0	9.2 8.1	1.8 5.4	4.8 4.0	1.9 4.0
	Wed	11/19/08	7:15 AM	5,510.5	11,236.6	13.9	13.9	NR	NR	NA NA	7	11	10	10	-4	-3	-3	0	1,555.7	257,400	309	1710 1707	1921.6	14.7	3.4	4.6	5.5	5.5
120	Thu Fri	11/20/08	7:00 AM 7:30 AM	5,523.8 5,537.7	11,250.0 11,264.3	13.3 13.9	13.4 14.3	NR NR	NR NR	NA NA	37 37	30 36	35 31	16 17	7	2 6	21	335 318	1,798.8 2,054.6	243,100 255,800	303 302	1713 1711 1715 1712	1932.3 1943.2	10.7	7.0	0.8 6.4	5.7	0.0 6.4
	Sat	11/21/08	8:00 AM	5,550.4	11,204.3	12.7	12.5	NR	NR	NA NA	7	11	10	0	-4	-3	7	0	2,054.6	229,600	304	1716 1713	1943.2	6.8	NR	NR	3.9	7.4
	Sun	11/23/08	8:00 AM	5,564.9	11,291.0	14.5	14.2	NR	NR	NA	37	32	32	17	5	5	20	334	2,549.3	265,100	308	1717 1715	1960.6	10.6	NR	3.4	6.2	6.2
	Mon Tue	11/24/08	6:45 AM 6:50 AM	5,579.1 5,593.6	11,305.2 11,319.7	14.2 14.5	14.2 14.5	NR NR	NR NR	NA NA	37	10 35	10 33	0 16	-4 2	-4 4	21	333	2,807.1 307.0	257,800 307,000	303 353	1718 1716 1720 1718	1967.8 1982.2	7.2 14.4	9.7 0.9	9.0	5.8 0.8	5.8 4.7
	Wed	11/26/08	7:00 AM	5,607.0	11,333.0	13.4	13.3	NR	NR	NA	37	35	32	16	2	5	21	330	40.1	40,100	50	1721 1719	1989.4	7.2	3.3	7.4	4.5	5.3
121	Thu Fri	11/27/08	7:45 AM 10:30 AM	5,623.7 5.640.7	11,349.3 11.366.3	16.7 17.0	16.3 17.0	NR NR	NR NR	NA NA	44 44	39 40	3	14 15	5 4	41 44	30 29	180 167	341.4 649.3	301,300 307,900	304 302	1723 1721 1725 1723	2003.7	14.3 14.4	2.7 3.3	0.0	2.4 1.6	0.0
	Sat	11/29/08	9:00 AM	5,655.1	11,380.3	14.4	14.0	NR	NR	NA	33	32	33	15	1	0	18	320	906.6	257,300	302	1726 1725	2028.7	10.6	7.4	4.1	5.1	4.2
	Sun	11/30/08	NR 7:30 AM	5,668.7 5,684.8	11,394.0	13.6 16.1	13.7 16.0	NR NR	NR NR	NA NA	38	31 11	31 10	15 10	7 -4	-3	23 -3	317	1,152.0 1.442.3	245,400 290,300	300 301	1727 1726 1729 1728	2035.9	7.2 14.0	9.9	9.0 5.5	6.8 3.4	6.8 3.4
	Tue	12/02/08	7:00 AM	5,699.3	11,424.5	14.5	14.5	NR	NR	NA	37	35	32	17	2	5	20	318	1,706.3	264,000	303	1731 1730	2064.2	14.3	1.7	3.2	2.0	1.9
122	Wed Thu	12/03/08 12/04/08	7:00 AM 6:50 AM	5,713.5 5,727.0	11,438.8 11,452.2	14.2 13.5	14.3 13.4	NR NR	NR NR	NA NA	37 44	34 38	31	15 14	3 6	6 43	22 30	309 161	1,950.1 2,195.9	243,800 245,800	285 305	1733 1732 1734 1733	2078.6 2085.4	14.4 6.8	3.7 6.1	6.1 0.0	0.0 5.4	0.0
122	Fri	12/05/08	7:00 AM	5,741.3	11,466.0	14.3	13.4	NR	NR	NA NA	38	29	33	16	9	5	22	290	2,193.9	245,000	291	1734 1735	2096.4	11.0	9.7	4.6	7.9	5.3
	Sat Sun	12/06/08	8:00 AM 8:00 AM	5,755.9 5,769.6	11,480.9 11,496.0	14.6 13.7	14.9 15.1	NR NR	NR NR	NA NA	36 37	31 33	33 34	16 16	5	3	20	306 315	2,696.2 2,930.9	255,300 234,700	289 272	1737 1737 1738 1738	2110.8 2118.0	14.4 7.2	6.6 8.5	1.5 4.5	6.1 6.6	0.3 6.7
<b>—</b>	Mon	12/07/08	6:55 AM	5,785.3	11,496.0	15.7	14.2	NR	NR NR	NA NA	37	30	30	16	7	7	21	288	3,196.1	265,200	296	1739 1739		7.2	9.9	8.4	4.7	4.7
	Tue	12/09/08	7:05 AM	5,798.9	11,523.9	13.6	13.7	NR	NR	NA	37	33	31	15	4	6	22	297	151.1	151,100	184	1740 1740	2132.4	7.2	10.0	10.7	6.4	6.4
123	Wed Thu	12/10/08	7:00 AM 7:00 AM	5,812.8 5,828.2	11,537.7 11,552.9	13.9 15.4	13.8 15.2	NR NR	NR NR	NA NA	44 38	38	1 36	14 16	6 5	43	30 22	139 310	392.1 640.8	241,000 248,700	290 271	1741 1741 1742 1743	2139.5 2150.1	7.1 10.6	8.4 8.4	0.0	5.7 4.9	0.0
	Fri	12/12/08	NR	5,842.8	11,567.3	14.6	14.4	NR	NR	NA	39	31	34	17	8	5	22	280	890.0	249,200	286	1743 1744	2157.3	7.2	11.7	5.3	7.4	5.2
	Sat	12/13/08	NR NR	5,856.1 5.870.3	11,581.2 11,595.6	13.3	13.9 14.4	NR NR	NR NR	NA NA	38 37	32 32	35 32	15 15	6 5	3 5	23	320 298	1,095.0	205,000 248,200	251 289	1745 1745 1747 1747	2164.2	6.9 7.1	8.1 8.9	0.8	4.5 6.1	6.2
	Mon	12/15/08	7:00 AM	5,886.7	11,611.3	16.4	15.7	NR	NR	NA	38	35	36	15	3	2	23	302	1,630.2	287,000	298	1747 1748	2186.4	15.1	5.2	2.0	4.6	2.8
	Tue Wed	12/16/08	7:00 AM 7:00 AM	5,901.7 5.914.1	11,626.2 11,639.8	15.0 12.4	14.9 13.6	NR NR	NR NR	NA NA	37 37	31	35 31	15 15	6	6	22	310 298	1,886.8 2.120.8	256,600 234.000	286 301	1749 1750 1751 1751	2200.1 2211.0	13.7 10.9	6.3 5.3	1.6 7.8	3.6 5.3	0.9 5.3
124	Thu	12/18/08	8:00 AM	5,929.4	11,655.0	15.3	15.2	NR	NR	NA NA	NR	NR	NR	NR	NA NA	NA NA	NA	NR	2,390.1	269,300	294	1754 1754	2232.6	21.6	1.5	2.9	0.4	2.0
	Fri Sat	12/19/08	8:00 AM 8:30 AM	5,945.3 5,958.5	11,670.1 11,683.4	15.9 13.2	15.1 13.3	NR NR	NR NR	NA NA	7	12 38	11 31	10 15	-5 -1	-4 6	-3 22	0 295	2,647.2 2,869.1	257,100 221,900	277 279	1756 1756 1758 1758	2247.0 2261.3	14.4 14.3	2.8 0.2	5.6 5.8	1.6	4.8 6.9
	Sun	12/20/08	9:00 AM	5,958.5	11,683.4	16.0	15.5	NR NR	NR NR	NA NA	37	38	35	16	-1	2	22	295	3,131.9	262,800	279	1760 1761	2261.3	18.2	0.2	0.7	0.0	0.0
	Mon	12/22/08	9:00 AM	5,990.1	11,714.5	15.6	15.6	NR	NR	NA	36	35	34	17	11	2	19	305	117.1	117,100	125	1762 1763	2293.1	13.6	1.2	1.6	0.0	0.0
	Tue Wed	12/23/08	7:00 AM NR	6,002.8 6.018.5	11,727.2 11.743.2	12.7 15.7	12.7 16.0	NR NR	NR NR	NA NA	37 39	33	33 34	16 17	4 8	5	21	282	325.9 585.4	208,800 259,500	274 273	1763 1764 1766 1766	2300.3 2336.2	7.2 35.9	5.5 11.0	5.0 5.9	4.5 7.9	4.3 5.0
125	Thu	12/25/08	9:00 AM	6,035.6	11,759.8	17.1	16.6	NR	NR	NA	43	47	36	13	-4	7	30	148	871.7	286,300	283	1768 1769	2336.2	0.0	0.0	7.0	0.0	7.2
	Fri Sat	12/26/08	NR NR	6,048.4 6,066.5	11,772.3 11,790.2	12.8 18.1	12.5 17.9	NR NR	NR NR	NA NA	5 37	12 36	10 34	10 16	-7 1	-5 3	-5 21	280	1,075.6 1,367.4	203,900 291,800	269 270	1770 1771 1773 1774	2350.2 2371.4	14.0 21.2	3.7 2.0	3.0 2.7	5.5 0.6	5.5 0.6
	Sun	12/28/08	NR	6,078.4	11,802.6	11.9	12.4	NR	NR	NA	37	36	33	15	1	4	22	285	1,539.3	171,900	236	1775 1776	2385.4	14.0	0.6	1.0	0.7	0.7
	Mon Tue	12/29/08	7:00 AM 7:00 AM	6,092.4	11,816.1 11,831.5	14.0 15.4	13.5 15.4	NR NR	NR NR	NA NA	40 39	33	34 34	16 15	7	6 5	24	268 278	1,764.7 2,012.8	225,400 248,100	273 269	1776 1777 1778 1779	2392.2 2406.6	6.8 14.4	7.6 7.8	7.3	5.4 4.7	5.3 4.7
	Wed	12/31/08	7:00 AM	6,125.6	11,849.2	17.8	17.7	NR	NR	NA NA	38	37	35	15	1	3	23	293	2,304.9	292,100	274	1781 1782	2428.9	22.3	1.5	1.9	0.8	8.8
126	Thu Fri	01/01/09 01/02/09	12:00 PM 7:00 AM	6,144.7 6,154.7	11,868.1 11,878.1	19.1 10.0	18.9 10.0	NR NR	NR NR	NA NA	39 39	34 37	33 36	16 15	5	6	23 24	284 292	2,621.0 2,794.1	316,100 173,100	277 289	1783 1784 1785 1786	2442.8 2457.6	13.9 14.8	6.1 1.5	6.5	2.4	2.4
	Sat	01/02/09	7:00 AM	6,170.0	11,893.4	15.3	15.3	NR	NR	NA NA	39	35	34	15	4	5	24	285	3,048.0	253,900	276	1787 1788	2471.6	14.0	3.2	4.8	6.2	6.1
	Sun	01/04/09	8:00 AM	6,185.6	11,909.5	15.6 15.6	16.1 15.1	NR	NR	NA	38	39	34	15	-1	4	23	290	31.8	31,800 247,500	33	1790 1791	2493.5 2504.5	21.9 11.0	0.2	2.5	0.0 4.7	3.8
	Mon Tue	01/05/09	7:00 AM 6:55 AM	6,201.2 6,216.7	11,924.6 11.939.7	15.5	15.1	NR NR	NR NR	NA NA	39 39	36 37	35 37	15	3	2	-233 24	275 290	279.3 533.0	253,700	269 276	1791 1793 1794 1797	2504.5	24.3	8.1 1.8	0.7	1.5	0.0
407	Wed	01/07/09	6:55 AM	6,230.7	11,953.2	14.0	13.5	NR	NR	NA	44	45	42	0	-1	2	44	147	769.2	236,200	286	1797 1801	2553.7	24.9	1.6	2.0	1.0	1.0
127	Thu Fri	01/08/09	7:00 AM 7:00 AM	6,247.3 6,263.5	11,968.9 11.985.1	16.6 16.2	15.7 16.2	NR NR	NR NR	NA NA	38 39	34	35 34	15 15	2	5	23 24	283	1,041.5 1.312.9	272,300 271.400	281 279	1801 1808 1805 1812	2593.0 2621.8	39.3 28.8	2.3	0.8 2.6	1.7 0.6	0.0 2.4
	Sat	01/10/09	8:00 AM	6,279.7	12,000.8	16.2	15.7	NR	NR	NA	39	35	37	15	4	2	24	288	1,578.2	265,300	277	1808 1816	2646.4	24.6	2.9	1.0	1.6	0.0
-	Sun Mon	01/11/09	7:30 AM 7:15 AM	6,293.8 6,310.4	12,014.6 12.031.4	14.1 16.6	13.8 16.8	NR NR	NR NR	NA NA	44 39	38	41 32	14	43	7	30 22	164 293	1,808.1 2,087.5	229,900 279,400	275 279	1810 1819 1814 1822	2664.2 2684.5	17.8 20.3	0.0	0.6 3.5	0.0	0.0 3.8
	Tue	01/13/09	7:10 AM	6,325.4	12,045.9	15.0	14.5	NR	NR	NA	39	33	32	15	6	7	24	283	2,332.1	244,600	276	1816 1825	2706.9	22.4	5.1	5.6	4.0	4.0
128	Wed Thu	01/14/09	7:10 AM 7:00 AM	6,341.1 6.356.6	12,061.7 12.076.7	15.7 15.5	15.8 15.0	NR NR	NR NR	NA NA	39 44	36 4	39 40	16 14	3 40	0 4	23 30	291 168	2,584.1 2.836.6	252,000 252,500	267 276	1819 1828 1821 1831	2728.0 2745.9	21.1 17.9	1.4	2.4 0.1	1.1 0.0	1.1 0.7
120	Fri	01/16/09	7:05 AM	6,375.1	12,076.7	18.5	18.9	NR	NR	NA NA	39	38	33	15	1	6	24	275	3,139.5	302,900	270	1825 1834	2771.5	25.6	1.1	4.0	0.0	1.0
	Sat	01/17/09	8:00 AM	6,391.4	12,111.5	16.3	15.9	NR	NR	NA	43	5	34	13	38	9	30	157	125.2	125,200	130	1827 1837	2789.2	17.7	0.0	3.6	0.0	4.5
<b>—</b>	Sun Mon	01/18/09	8:00 AM 6:50 AM	6,409.6 6,424.5	12,129.3 12,143.4	18.2 14.9	17.8 14.1	NR NR	NR NR	NA NA	39 44	37	35 41	16 14	2 41	3	23 30	287 167	421.9 654.0	296,700 232,100	275 267	1831 1841 1833 1844	2818.0 2837.2	28.8 19.2	1.7 0.0	2.4 0.0	0.0 1.1	0.0
	Tue	01/20/09	6:55 AM	6,439.8	12,159.1	15.3	15.7	24.6	NR	NA	38	35	36	15	3	2	23	294	910.8	256,800	276	1837 1848	2864.1	26.9	2.2	0.9	0.0	0.0
129	Wed Thu	01/21/09	6:50 AM 6:45 AM	6,456.2 6.473.7	12,174.9 12,191.1	16.4 17.5	15.8 16.2	31.5 NR	NR NR	NA	38 39	38 37	35 37	15 15	0 2	3	23 24	295 295	1,184.1 1.459.5	273,300 275,400	283 273	1842 1854 1846 1861	2904.2 2944.2	40.1 40.0	0.2 1.0	0.6	0.0	0.0
-20	Fri	01/23/09	7:00 AM	6,492.1	12,207.9	18.4	16.8	NR	NR	NA	40	34	33	15	6	7	25	276	1,745.1	285,600	271	1849 1868	2979.4	35.2	3.1	1.3	3.4	0.0
	Sat Sun	01/24/09	NR NR	6,510.2 6.528.2	12,225.3 12.241.5	18.1 18.0	17.4 16.2	NR NR	NR NR	NA NA	NR 39	NR 38	NR 32	NR 15	NA 1	NA 7	NA 24	NR 285	2,045.6 2.327.9	300,500 282,300	282 276	1854 1875 1858 1883	3022.1 3064.7	42.7 42.6	NR 0.3	NR 1.8	NR 0.0	NR 0.0
	Mon	01/26/09	7:00 AM	6,545.2	12,258.1	17.0	16.6	NR	NR		39	38	33	15	1	6	24	277	2,582.2	254,300	252	1862 1888	3096.4	31.7	0.7	1.8	0.0	1.3
	Tue Wed	01/27/09	7:30 AM 7:30 AM	6,562.7 6,579.4	12,274.6 12,290.1	17.5 16.7	16.5 15.5	NR NR	NR NR		39 39	35 34	36 37	15 15	4 5	3	24 24	278 288	2,855.5 3,122.0	273,300 266,500	268 276	1866 1894 1869 1900	3131.6 3164.2	35.2 32.6	2.0	0.9	0.9	0.0
130	Thu	01/29/09	7:30 AM	6,597.6	12,306.7	18.2	16.6	NR	NR		40	33	34	15	7	6	25	268	125.7	-2,996,300	-2,876	1874 1909	3214.9	50.7	2.2	0.9	1.4	0.0
	Fri Sat	01/30/09	7:15 AM 7:30 AM	6,615.5 6.632.2	12,323.3 12,340.0	17.9 16.7	16.6 16.7	NR 8.5	NR NR		40 44	32 4	38 36	15 15	8 40	2 8	25 29	0	312.7 322.3	187,000 9.600	181	1880 1918 1887 1926	3264.7 43.0	49.8 -3221.7	2.4 0.0	0.0	0.0 1.2	0.0
1		02/01/09	7:00 AM	6,645.0	12,340.0	12.8	12.6	19.5	NR		26	23	23	24	3	3	2	0	323.0	700	1	1891 1930		18.6	8.4	8.9	8.5	8.7

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet (Continued)

																Pressure I	Eiltration								Paol	kwash			$\neg$
									KMnO <sub>4</sub>							Fiessule	illi alion								Васі	wasii	Since I	Last BW	
								KMnO <sub>4</sub>	Tank 2	Estimated											Daily					Run	Run	Standby	Standby
	l			Tank A Hour		TA Run	TB Run	Tank 1	Level	KMnO <sub>4</sub>		Outlet	Outlet				Inlet-	Flow	Totalizer to	Gallon	Average	Tank	Tank	Total	Daily	Time	Time	Time	Time
Week No.	Day		Time	Meter	Meter hrs	Time	Time hrs	Level <sup>(a)</sup> inches	(Iron) inches	Dosage µg/L as Mn	Influent psig	Tank A psig	Tank B psig	Effluent	Inlet-TA psig	Inlet-TB psig	Effluent psig	gpm	Distribution kgal	Usage	Flowrate	A No.	B No.	Volume kgal	Volume kgal	Tank A hrs	Tank B hrs	Tank A hrs	Tank B hrs
110.	Moi	n 02/02/0	6:50 AM	6,655.7	12,363.3	10.7	10.7	NR	NR	<b>#</b> 8 =	26	22	21	23	4	5	3	0	323.0	0	0	1891	1930	NR	#VALUE!	19.2	18.2	20.6	20.5
	Tue			6,665.0 6.675.9	12,373.6 12.384.9	9.3 10.9	10.3 11.3	NR NR	NR NR		34 33	28 30	31 30	16 16	6	3	18 17	0 373	323.0 536.6	213,600	0 321	1895 1897	1933	82.4 88.5	#VALUE!	4.5 2.1	1.6 3.7	5.5 1.7	3.4 5.1
131	Thu			6,687.1	12,396.1	11.2	11.2	NR	NR		34	28	30	16	6	4	18	368	775.0	238,400	355	1898	1935	92.3	3.8	6.3	4.4	7.7	7.1
	Fri	0210010		6,699.4	12,408.6	12.3	12.5	NR	NR		35	27	27	16	8	8	19	345	1,027.5	252,500	339		1936	98.4	6.1	4.5	7.7	6.8	8.5
	Sar			6,711.5 6.723.5	12,420.8 12,433.0	12.1 12.0	12.2 12.2	NR NR	NR NR		33 30	28 25	31 25	16 15	5	5	17 15	375 372	1,274.8 1.523.2	247,300 248.400	339 342	1902 1904	1938	106.9 113.8	8.5 6.9	4.4 4.8	1.1 4.4	7.4 6.7	1.2 6.7
	Mor			6,735.9	12,445.9	12.4	12.9	35.0	NR		28	28	16	NR	0	12	#VALUE!	346	1,778.1	254,900	336	1906		120.3	6.5	5.1	7.7	5.9	6.4
	Tue			6,746.5 6,757.9	12,456.7	10.6 11.4	10.8	NR NR	NR NR		33	30	30	16 16	3	3	17 19	364 359	2,011.4	233,300	363	1909 1911	1942 1944	131.0 139.1	10.7 8.1	0.8	2.9	0.6 6.2	5.7
132	Wed			6,757.9	12,468.0 12,480.0	11.4	11.3	NR NR	NR NR		35	28 30	32 29	16	3	4	19	359	2,245.6 2.488.0	234,200 242,400	344 338		1944	139.1	18.3	1.1	2.8	1.0	2.5 5.0
	Fri			6,781.5	12,492.2	11.7	12.2	NR	NR		41	39	1	15	2	40	26	263	2,732.4	244,400	341		1948	163.7	6.3	0.3	0.0	0.0	0.0
	Sar			6,791.1	12,501.9	9.6 NA	9.7 NA	NR ND	NR ND		9 ND	9	9 ND	NR ND	0 #VALUE!	0 #VALUE!	#VALUE!	NR	2,942.7	210,300 #VALUE!	363 #VALUE!	1922	1951	176.3	12.6 #VALUE!	1.1	0.6	3.1	3.1
	Mor			6,516.1	12,528.0	NA NA	NA NA	26.0	NR		7	10	10	10	-3	-3	-3	0	205.8	#VALUE!	#VALUE!	1931	1956	190.1	#VALUE!	0.7	3.0	0.3	5.6
	Tue			6,827.9	12,528.0	NA	0.0	NR	NR		8	11	10	10	-3	-2	-2	0	436.7	230,900	#VALUE!	1935	1959	220.7	30.6	2.2	1.2	3.7	1.5
133	Thu			6,839.7 6,851.1	12,552.6 12,564.6	11.8 11.4	24.6 12.0	7.0	NR NR		34 33	28 31	29 29	16 17	6	5 4	18 16	348 340	681.9 922.9	245,200 241,000	256 344	1939 1945	1961 1964	234.1 253.2	13.4 19.1	0.0	4.3 2.6	0.0	5.0 3.4
	Fri	02/20/0	6:55 AM	6,861.9	12,575.9	10.8	11.3	16.0	NR		34	32	29	18	2	5	16	346	1,159.6	236,700	357	1949	1966	265.8	12.6	0.1	4.2	0.0	5.6
	Sar			6,873.6 6,885.0	12,588.0 12,600.0	11.7 11.4	12.1 12.0	26.0 34.0	NR NR		7	10 29	10 31	10	-3 5	-3	-3 17	0 352	1,397.5 1,637.3	237,900 239,800	333 342	1952 1956	1968	276.6 289.6	10.8 13.0	2.3 1.2	3.5 2.0	5.4 3.6	6.2 5.2
	Mor			6.897.2	12,627.0	12.2	NA	NR	NR		33	29	31	17	4	2	16	360	1,887.3	250,000	#VALUE!	1960	1972	302.5	12.9	1.8	1.4	4.5	4.5
	Tue	02/24/0	6:50 AM	6,909.7	12,625.8	12.5	NA	NR	NR		6	10	10	10	-4	-4	-4	0	2,146.3	259,000	#VALUE!	1965	1974	317.1	14.6	0.8	1.0	2.4	2.4
134	Thu			NR 6 933 7	12,639.2 12,651.3	NA NA	13.4 12.1	NR NR	NR NR		33 44	30 42	31 42	16 NR	3	2	17 #VALUE!	259 137	2,410.2 2,649.8	263,900 239,600	#VALUE!	1970 1974	1976	332.4 343.5	15.3 11.1	0.6 2.1	0.3 5.6	0.8 4.5	0.8 6.3
154	Fri		6:55 AM	6,946.0	12,644.1	12.3	NA	0.0	NR		8	11	10	NR	-3	-2	#VALUE!	0	2,908.6	258,800	#VALUE!	1978	1979	356.5	13.0	0.8	3.1	0.1	5.2
	Sa			6,958.1 6,978.9	12,676.5 12,689.7	12.1 20.8	NA 13.2	9.0 18.5	NR		34	29 28	31 31	16	5	3	18 17	363 362	3,155.1	246,500	#VALUE!	1981 1985		366.8	10.3 12.3	2.5	1.6 1.4	4.8	3.5 4.2
	Sur			6,978.9	12,689.7	5.2	15.8	28.0	NR NR		34 34	28	30	17	6	3	17	340	139.5 414.1	-3,015,600 274.600	-3,112 585	1985	1983	379.1 391.7	12.3	1.8	2.1	4.2	4.2
	Tue			6,997.2	12,717.3	13.1	11.8	36.0	NR		33	29	28	16	4	5	17	345	679.5	265,400	356	1993	1987	404.7	13.0	1.0	3.3	1.0	4.5
135	We			7,009.1 7,021.5	12,729.4 12,742.3	11.9 12.4	12.1 12.9	8.0 16.0	NR NR		33 41	29 36	30 50	17	5	-9	16 26	363 255	920.1 1.170.9	240,600 250.800	334 331	1996	1989	415.4 426.1	10.7	1.0	2.0	2.1	2.1 0.0
135	Fri			7,021.5	12,742.3	12.4	13.0	26.0	NR		34	32	26	16	2	-9	18	353	1,170.9	250,000	328	2002		434.9	8.8	0.1	5.5	0.9	6.3
	Sa	t 03/07/0	8:00 AM	7,047.1	12,768.8	13.2	13.5	NR	NR		34	31	27	17	3	7	17	360	1,688.0	267,100	334	2005	1994	446.0	11.1	0.5	4.4	0.0	6.3
	Sur			7,059.3 7,083.3	12,780.7 12,794.8	12.2 24.0	11.9 14.1	NR NR	NR NR		33 27	28 22	31 18	17	5	2 9	16 14	366 357	1,927.1 2.203.6	239,100 276,500	331 259	2007	1996	454.5 460.6	8.5 6.1	2.4 5.1	0.3 5.8	5.1 5.1	0.8 5.1
	Tue	03/10/0	7:00 AM	7,087.2	12,809.2	3.9	14.4	NR	5.0		35	29	25	16	6	10	19	332	2,486.8	283,200	769	2013	1999	473.6	13.0	1.3	4.1	1.0	5.2
136	We			7,099.7 7.112.7	12,822.1	12.5 13.0	12.9	NR	12.0		33	30	27	16	3 6	6	17 18	346	2,743.4	256,600	337	2016	2001	484.3	10.7 10.7	1.0	4.2	0.8	5.6
130	Fri			7,112.7	12,835.0 12.847.5	11.7	12.9 12.5	NR NR	20.0		34 35	28 29	30 26	16 16	6	9	18	350 322	3,005.9 3.244.3	262,500 238,400	338 329	2019	2003	495.0 503.7	8.7	1.8	2.0 7.0	2.3	2.5 5.9
	Sa			7,136.0	12,859.5	11.6	12.0	NR	32.0		34	28	30	15	6	4	19	337	202.3	-3,042,000	-4,298	2025	2006	514.1	10.4	2.7	4.9	6.2	6.2
	Sur			7,150.0 7.161.0	12,874.2 12.885.6	14.0 11.0	14.7 11.4	NR NR	NR 36.0		34 42	29 51	32 38	15 15	-9	2	19 27	365 191	480.8 703.7	278,500 222,900	324 332	2029	2008	527.1 535.8	13.0 8.7	2.2 0.0	1.8	0.6	0.6 2.3
	Tue	03/17/0	7:00 AM	7,174.0	12,898.8	13.0	13.2	NR	36.0		36	26	30	15	10	6	21	330	953.5	249,800	318	2034	2010	542.3	6.5	3.8	5.3	5.8	5.8
137	We			7,188.6	12,913.3	14.6 14.0	14.5 14.3	NR	NR		36	30	26	15	6	10 5	21 19	337	1,232.8	279,300	320	2037	2011	551.2	8.9 13.0	2.6 0.1	4.0	10.2 0.0	5.7
137	Fri			7,202.6 7,216.0	12,927.6 12,941.7	13.4	14.3	NR NR	0.0 NR		34 34	33 32	29 30	15 15	2	4	19	345 343	1,512.9 1,776.2	280,100 263,300	330 319	2041		564.2 576.9	12.7	0.1	5.0 0.0	4.0	5.2 4.7
	Sa			7,230.6	12,957.5	14.6	15.8	NR	NR		35	33	27	15	2	8	20	337	2,076.9	300,700	330	2050		592.1	15.2	0.0	5.7	0.0	5.3
	Sur			7,243.9 7,256.6	12,970.6 12,983.9	13.3 12.7	13.1 13.3	NR NR	NR 13.0		35 34	28 33	32 28	15 15	7	3	20 19	341 350	2,338.6 2,595.7	261,700 257,100	330 330	2053 2058		604.3 619.5	12.2 15.2	2.6 0.2	1.3 3.5	0.8	0.1 2.7
	Tue		7:00 AM	7,269.6	12,997.3	13.0	13.4	NR	17.0		44	44	43	15	0	1	29	156	2,862.2	266,500	337	2063	2025	635.5	16.0	0.0	1.9	0.0	2.4
138	We			7,282.4 NR	13,010.4 NR	12.8 NA	13.1 NA	NR NR	4.0 NR		35 NR	33 NR	30 NR	15 NR	2 #VALUE!	5 #VALUE!	20 #VALUE!	340 NR	3,117.0 NR	254,800 #VALUE!	328 #VALUE!	2067 NR	2027	648.1 NR	12.6 #VALUE!	0.6 NR	4.1 NR	0.7 NR	5.8 NR
130	Fri			7,294.0	13,022.3	NA NA	NA NA	NR	10.0		39	20	23	15	19	#VALUE:	#VALUE:	245	68.6	#VALUE!	#VALUE!	2070	2029	658.7	#VALUE!	2.6	4.0	5.1	5.1
	Sa			7,313.0	13,041.5	19.0	19.2	NR	13.0		46	15	48	15	31	-2	31	362	238.7	170,100	148	2070	2029	658.7	0.0	21.5	6.0	23.3	6.0
	Sur			7,327.2 7,327.7	13,055.8 13,056.3	14.2 0.5	14.3 0.5	NR NR	16.0 19.0		33	32 30	32 31	16 17	3	1 2	17 16	365 368	509.9 513.2	271,200 3,300	317 110	2071	2030	662.5 662.5	3.8 0.0	11.8 12.3	7.6 14.1	7.6 8.9	7.6 8.9
	Tue	03/31/0	7:00 AM	7,327.7	13,056.3	0.0	0.0	NR	22.0		38	23	26	15	15	12	23	306	513.7	500	#DIV/0!	2071	2030	662.5	0.0	12.3	14.1	8.9	8.9
139	We		0.47 7 1111	7,339.4 7,352.5	13,068.1 13.081.3	11.7 13.1	11.8 13.2	NR NR	24.0 25.0		33 34	31 28	27	18 16	2	6	15 18	335 340	737.4 987.7	223,700 250,300	317 317	2073	2031	668.6 677.3	6.1 8.7	0.9 3.5	5.6 4.7	0.8 5.7	6.1 5.7
139	Fri			7,365.4	13,094.4	12.9	13.1	NR NR	26.0		34	30	29 29	16	4	5	18	353	1,234.9	247,200	317		2035	687.6	10.3	1.5	3.4	1.2	4.6
	Sa			7,378.3	13,107.3	12.9	12.9	NR	28.0		33	31	31	17	2	2	16	370	1,482.3	247,400	320	2081		697.8	10.2	0.0	0.9	0.0	0.0
-	Sur			7,391.4 7.404.6	13,120.1 13,134.4	13.1 13.2	12.8 14.3	NR NR	NR NR		34 33	31 31	28 30	16 17	3 2	6	18 16	355 350	1,745.1 1,979.6	262,800 234,500	338 285		2039	706.0 715.2	8.2 9.2	6.9 0.3	3.1	1.0	4.8 5.3
	Tue	04/07/0	6:55 AM	7,418.3	13,148.2	13.7	13.8	NR	29.0		33	31	29	19	2	4	14	342	2,241.1	261,500	317	2089	2042	725.5	10.3	0.8	4.1	0.0	6.0
140	We			7,430.9 7,443.6	13,161.3 13,174.7	12.6 12.7	13.1 13.4	NR NR	30.0 30.0		7 34	10 31	10 30	10 17	-3 3	-3 4	-3 17	0 334	2,482.5 2,730.4	241,400 247,900	313 317	2092		736.4 749.3	10.9 12.9	1.3 0.5	3.3 2.7	1.8 0.0	5.3 5.1
140	Fri			7,443.6	13,174.7	12.7	13.4	NR NR	30.0		34	31 29	20	17	1	10	17	334	2,730.4	247,900 258,700	317		2046	749.3 766.0	12.9 16.7	0.5	4.4	0.0	6.0
	Sa	t 04/11/0	8:00 AM	7,472.1	13,205.4	15.5	16.7	NR	33.0		30	30	30	18	0	0	12	344	17.9	-2,971,200	-3,080	2109	2051	788.0	22.0	0.7	2.4	0.7	3.4
	Sur			7,488.2 7,500.2	13,222.2 13,234.9	16.1 12.0	16.8 12.7	NR NR	33.0 30.5		31 32	31 31	20 30	18 16	0	11	13 16	350 370	313.0 546.9	295,100 233,900	299 316	2115	2054	807.3 822.4	19.3 15.1	0.1	0.4 1.5	0.0	0.0
	Tue			7,500.2	13,234.9	12.0	13.3	NR NR	30.5		48	50	49	0	-2	-1	48	0	800.3	253,400	316	2120		835.3	15.1	0.1	4.0	0.0	5.4
1	Wee	d 04/15/0	6:55 AM	7,524.3	13,260.3	11.2	12.1	NR	30.5		40	37	1	15	3	39	25	250	1,041.3	241,000	345	2128	2060	848.2	12.9	0.0	0.0	0.0	0.0
141	Thu			7,538.6 7.552.7	13,274.9 13.290.0	14.3 14.1	14.6 15.1	NR NR	30.5 31.0		34 28	30 26	29 25	17	2	5	17 14	346 395	1,319.3 1.577.8	278,000 258,500	321 295	2132	2063	863.4 880.0	15.2 16.6	1.2	3.4 1.9	2.2 0.0	4.8 1.0
	Sa	t 04/18/0	8:00 AM	7,566.6	13,304.2	13.9	14.2	NR	31.0		33	26	31	16	7	2	17	336	1,849.6	271,800	322	2141	2069	894.8	14.8	3.0	0.2	2.8	0.0
	Sur	04/19/0	8:00 AM	7,577.8	13,315.8	11.2	11.6	NR	31.0		33	29	30	17	4	3	16	345	2,085.1	235,500	344	2149	2071	909.3	14.5	0.5	1.5	1.1	3.1

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet (Continued)

																													$\neg$
									KMnO <sub>4</sub>				l			Pressure	Filtration		ı			-	1		Back	wash	Since I	ast BW	
								KMnO <sub>4</sub>	Tank 2	Estimated											Daily				-	Run			Standby
				Tank A Hour		TA Run	TB Run	Tank 1	Level	KMnO₄		Outlet	Outlet				Inlet-	Flow	Totalizer to	Gallon	Average	Tank		Total	Daily	Time	Time	Time	Time
Weel No.	Day o		Time	Meter hrs	Meter hrs	Time	Time hrs	Level <sup>(a)</sup> inches	(Iron) inches	Dosage µg/L as Mn	Influent psig	Tank A psig	Tank B psig	Effluent psia	Inlet-TA psig	Inlet-TB psig	Effluent psig	rate gpm	Distribution kgal	Usage gal	Flowrate gpm	No.	B No.	Volume kgal	Volume kgal	Tank A hrs	Tank B hrs	Tank A	Tank B hrs
NO.	Mon				13,330.8	14.1	15.0	NR	31.5	ду/с аз инг	33	31 31	30 30	17	2	3	16	339	2,361.5	276,400	317	2153		931.2	21.9	0.5	0.9	0.0	0.0
	Tue		6:55 AM 7:30 AM	7,603.9	13,343.1	12.0	12.3	NR	2.0		34	29	32	17	5	2	17 17	340	2,601.7	240,200	330	2157		946.0	14.8	1.1	0.1	1.0	0.0
142	Wed		8:30 AM	7,617.3 7.630.2	13,356.8 13,370.0	13.4 12.9	13.7 13.2	NR NR	NR NR		33	29 30	31 29	16 17	2	3	17	352 361	2,860.4 3.113.3	258,700 252,900	318 323	2161 2165		960.5 974.8	14.5	1.6	1.5	0.8	0.0
	Fri	04/24/09	6:55 AM	7,642.3	13,382.6	12.1	12.6	NR	NR		32	30	29	15	2	3	17	346	80.4	-3,032,900	-4,095	2169	2086	989.4	14.6	0.9	1.4	1.4	0.7
	Sat		7:00 AM	7,654.1 7.666.9	13,394.8 13,408.0	11.8 12.8	12.2 13.2	NR NR	NR NR		34 43	28 42	27 41	15 NR	6	7	19 #VALUE!	342 188	323.3 587.7	242,900 264,400	337 339	2172	2088	999.6 1013.9	10.2 14.3	2.7 1.7	4.9 3.6	4.8 3.5	5.4 6.0
	Mor	04/27/09		7,681.6	13,422.8	14.7	14.8	NR	2.0		33	30	27	15	3	6	18	345	892.4	304,700	344	2180	2094	1028.2	14.3	1.1	3.3	0.8	3.6
	Tue		7:00 AM 7:10 AM	7,694.5 7,706.9	13,435.9 13.448.4	12.9 12.4	13.1 12.5	NR NR	NR NR		33 32	28 31	30 30	15 17	5	3	18 15	341 351	1,152.9 1.399.2	260,500 246,300	334 330	2183		1040.6 1051.2	12.4 10.6	2.7	2.3 3.2	5.1 5.9	5.0 6.0
143		04/30/09	7:00 AM	7,719.4	13,461.0	12.5	12.6	NR	NR		34	29	31	16	5	3	18	342	1,643.1	243,900	324	2188	2101	1051.2	7.9	3.9	2.4	4.6	4.7
	Fri	05/01/09		7,731.7	13,473.3	12.3	12.3	NR	9.0		32	33	30	16	-1	2	16	352	1,887.8	244,700	332	2191		1069.6	10.5	0.3	1.8	0.0	3.0
	Sat		9:00 AM 9:30 AM	7,746.2 7,760.7	13,488.0 13,502.1	14.5 14.5	14.7 14.1	NR NR	NR NR		33 34	31 29	28 30	17 15	5	5 4	16 19	348 342	2,177.4 2,444.1	289,600 266,700	331 311	2193	2105 2107	1077.2 1085.8	7.6 8.6	1.4 5.3	3.1	1.0 7.4	5.3 6.7
	Mor	05/04/09		7,773.1	13,514.4	12.4	12.3		NR		33	30	32	16	3	1	17	360	2,681.0	236,900	320	2197		1093.7	7.9	4.1	0.1	4.6	0.0
	Tue			7,784.5 7.880.0	13,525.8	11.4 NA	11.4 15.1		NR NR		33 33	34 28	30 32	17 16	-1 5	3	16 17	343	2,914.5 3,207.7	233,500 293,200	341 #VALUE!		2110	1100.5 1106.5	6.8	0.3 7.8	3.9 0.6	0.0 4.9	6.1 0.0
144	Thu	05/07/09	7:00 AM	7,818.1	13,559.1	NA	18.2		NR		33	30	29	15	3	4	18	342	264.8	-2,942,900	#VALUE!	2203		1117.0	10.5	4.4	5.0	3.7	3.7
	Fri Sat	05/08/09	7:00 AM 8:00 AM	7,835.0 7.852.7	13,576.0 13,593.5	16.9 17.7	16.9 17.5		NR NR		32 32	33 32	31 31	16 16	-1 0	1	16 16	367 356	591.4 932.5	326,600 341,100	322 323	2206	2117	1129.1 1137.8	12.1 8.7	0.0 6.3	0.6 1.8	0.0	0.0
	Sun	05/10/09	8:00 AM	7,869.3	13,609.9	16.6	16.4		NR		33	31	31	16	2	2	17	351	1,255.9	323,400	327	2210	2121	1146.4	8.6	3.6	1.7	2.5	0.0
	Mor		7:00 AM 7:00 AM	7,884.1 7,897.7	13,625.0 13,638.4	14.8 13.6	15.1 13.4		NR 8.0		32 32	29 33	32 30	16 18	-1	0	16 14	340 342	1,541.5 1,816.7	285,600 275,200	318 340	2212		1152.4 1164.1	6.0 11.7	4.0 0.0	0.0	3.5 0.0	2.3
	Wed			7,911.8	13,652.0	14.1	13.6		18.0		34	29	33	16	5	1	18	340	2,084.3	267,600	322	2217		1173.5	9.4	4.1	0.0	5.3	0.0
145	Thu	05/14/09	6:55 AM 6:45 AM	7,924.7 7 937 4	13,665.2 13,677.9	12.9 12.7	13.2 12.7		28.0 36.0		6	12 34	11 29	10 16	-6 -1	-5 4	-4 17	350	2,333.8	249,500 244 100	319 320	2220	2130 2132	1184.4	10.9 10.2	2.4 0.6	2.6 5.4	5.5 0.6	5.5 5.4
	Sat	05/16/09	8:00 AM	7,950.4	13,690.9	13.0	13.0		30.0		33	6	13	11	27	20	22	330	2,827.5	249,600	320	2225		1204.8	10.2	3.1	2.3	5.4	5.4
	Sun			7,965.5	13,704.9	15.1	14.0		36.0		34	30	31	18	4	3	16	347	3,102.5	275,000	315		2138	1217.2	12.4	3.2	1.5	4.4	2.7
	Mor Tue		7:00 AM 7:00 AM	7,978.2 7.990.7	13,718.3 13.730.9	12.7 12.5	13.4 12.6		28.0		33 45	28 46	32 44	16 0	-1	1	17 45	330 71	85.9 332.6	-3,016,600 246,700	-3,855 328	2231 2235	2141	1228.8 1240.9	11.6 12.1	4.7 1.1	0.8 4.5	3.2 0.8	0.0 5.4
	Wed	05/20/09	7:00 AM	8,004.6	13,744.8	13.9	13.9		0.0		33	32	31	17	1	2	16	353	611.1	278,500	334	2238	2146	1253.6	12.7	0.3	0.6	0.0	0.0
146	Thu Fri	05/21/09	7:00 AM 7:00 AM	8,018.7 8,032.2	13,759.2 13,773.0	14.1 13.5	14.4 13.8		3.0 6.0		33	32 11	31 9	17 10	1 -4	-2	16 -3	351 0	888.8 1,153.5	277,700 264,700	325 323	2242 2245		1268.3 1280.7	14.7 12.4	0.0 2.6	1.0	0.0 4.9	0.0 3.1
	Sat	05/23/09	7:00 AM	8,045.2	13,786.3	13.0	13.3		8.0		34	32	29	16	2	5	18	349	1,409.2	255,700	324	2249	2155	1295.0	14.3	1.0	3.2	3.3	5.8
	Sun		7:15 AM 10:00 AM	8,059.7 8.075.8	13,800.7 13,816.6	14.5 16.1	14.4 15.9		12.0 16.0		42 34	49 31	38 31	NR 15	-7 3	3	#VALUE!	186 336	1,691.3 2,004.0	282,100 312,700	325 326	2252		1310.9 1325.1	15.9 14.2	0.0 2.4	1.1 2.0	0.0 1.6	2.9 1.5
	Tue	05/26/09	7:00 AM	8,087.9	13,828.5	12.1	11.9		19.0		32	33	30	18	-1	2	14	334	2,234.6	230,600	320	2259	2166	1337.5	12.4	0.7	1.1	1.0	1.0
147	Wed		7:00 AM 7:00 AM	8,099.9 8 114 2	13,840.0 13,854.2	12.0 14.3	11.5 14.2		22.0 27.0		32 30	33 30	32 27	16 17	-1 0	3	16 13	356 340	2,463.7 2,736.5	229,100 272,800	325 319	2262 2265		1351.8 1364.2	14.3 12.4	0.5	3.0	0.8	0.8 3.9
	Fri	05/29/09	7:00 AM	8,129.3	13,869.0	15.1	14.8		32.0		33	31	33	16	2	0	17	368	3,027.3	290,800	324	2268	2177	1380.4	16.2	2.2	0.0	2.5	0.0
	Sat		NR NR	NR 8 160 3	NR 13 900 5	NA NA	NA NA		NR NR		NR NR	NR NR	NR NR	NR NR	#VALUE!	#VALUE!	#VALUE!	NR NR	NR 352.7	#VALUE!	#VALUE!	NR 2278	NR 2188	NR 1413.1	#VALUE!	NR 0.0	NR 0.0	NR 0.0	NR 0.1
	Mor	06/01/09	7:00 AM	8,177.3	13,917.5	17.0	17.0		NR		33	30	31	15	3	2	18	340	688.7	336,000	329	2280	2190	1422.9	9.8	5.6	2.0	2.7	2.6
	Tue		7:00 AM 7:00 AM	8,193.3 8,207.3	13,933.3 13,947.1	16.0 14.0	15.8 13.8		NR NR		32 32	32 32	31 31	15 169	0	1	17 -137	363 343	1,005.5 1,283.3	316,800 277,800	332 333	2283 2285		1435.3 1443.6	12.4 8.3	0.6	0.1	0.0	0.0
148	Thu	06/04/09	7:00 AM	8,201.1	13,960.7	NA	13.6		NR		32	33	30	15	-1	2	17	352	1,557.1	273,800	#VALUE!	2287	2198	1451.9	8.3	0.4	2.1	0.0	2.8
	Fri Sat	06/05/09	7:00 AM 7:00 AM	8,233.0 8,247.9	13,972.4 13,987.1	NA 14.9	11.7 14.7		NR NR		43 42	44 40	43 43	0 15	-1 2	-1	43 27	160 350	1,801.7 2,096.7	244,600 295,000	#VALUE! 332	2288 2291		1458.3 1470.7	6.4 12.4	5.8	3.5 2.6	6.2 1.4	6.2 2.8
	Sun	06/07/09	9:00 AM	8,266.5	14,005.4	18.6	18.3		NR		32	30	30	15	2	2	17	343	2,452.9	356,200	322	2294	2207	1485.0	14.3	3.3	1.1	0.0	0.0
	Mor		7:00 AM 6:50 AM	8,279.0 8,294.2	14,018.0 14,033.5	12.5 15.2	12.6 15.5		NR NR		43 34	3 29	36 29	14 16	40 5	7 5	29 18	198 330	2,709.0 3,017.1	256,100 308,100	340 335	2296 2299	2209 2212	14933.0 1505.7	13448.0 -13427.3	0.0 4.7	3.1 4.2	0.0 4.6	5.1 4.7
	Wed	06/10/09	7:00 AM	8,310.4	14,049.8	16.2	16.3		NR		34	29	30	15	5	4	19	198	56.9	-2,960,200	-3,036	2302	2215	1518.1	12.4	3.9	2.8	4.5	3.2
149	Thu	06/11/09	7:00 AM	8,325.4 8,339.0	14,064.9 14,077.8	15.0 13.6	15.1 12.9		NR NR		32 20	32 24	31 22	16 23	-4	-2	16 -3	350 NR	357.2 430.3	300,300 73,100	333 92	2305	2218	1529.8 1529.9	11.7 0.1	1.1 8.2	0.7 8.3	0.0 6.6	6.6
	Sat			NR	NR	NA	NA		NR		NR	NR	NR	NR	#VALUE!	#VALUE!	#VALUE!	NR	NR	#VALUE!	#VALUE!	NR	NR	NR	#VALUE!	NR	NR	NR	NR
_	Sun	06/14/09		NR 8 386 3	NR 14 124 4	NA NA	NA NA		NR NR		NR 34	NR 30	NR 29	NR 16	#VALUE!	#VALUE!	#VALUE!	NR 335	NR 993.1	#VALUE!	#VALUE!	2311	2228	NR 1549.2	#VALUE!	NR 9.2	NR 77	NR 2.7	NR 2.7
	Tue	06/16/09	8:00 AM	8,403.5	14,141.8	17.2	17.4		NR		33	31	30	15	2	3	18	347	1,323.1	330,000	318	2314		1563.4	14.2	3.8	1.3	3.4	0.6
150	Wed		7:00 AM 7:30 AM	8,418.0 8,435.9	14,157.5 14 175.0	14.5 17.9	15.7 17.5		NR NR		32 34	32 27	29 32	15 15	7	3	17 19	349 330	1,461.7 1,796.0	138,600 334,300	153 315	2322	2235 2237	1567.6 1573.6	4.2 6.0	2.9 9.8	2.6	4.9 2.0	5.0 0.0
100	Fri	06/19/09	7:30 AM	8,454.1	14,193.3	18.2	18.3		NR		33	32	32	16	1	1	17	331	2,136.7	340,700	311	2325	2239	1581.9	8.3	4.4	0.3	2.0	0.0
	Sat		7:30 AM 7:30 AM	8,473.1 8,492.1	14,212.1 14,231.2	19.0 19.0	18.8 19.1		NR NR		34 33	26 30	33 32	15 16	8	1	19 17	315 331	2,486.9 2,832.8	350,200 345,900	309 303	2326 2328	2241	1587.9 1596.2	6.0 8.3	11.1 6.1	0.2	3.7	0.0
	Mor	00.200	7:00 AM	8,510.8	14,250.2	18.7	19.0		NR		34	36	25	16	-2	9	18	316	3,173.1	340,300	301	2330	2244	1602.6	6.4	0.5	9.4	0.0	2.3
	Tue		7:00 AM 7:00 AM	8,527.1 8,545.8	14,266.1 14,235.1	16.3	15.9 NA		NR NR		34 34	26 28	32 31	15 16	8	3	19 18	330 329	80.1 439.8	-3,093,000 359,700	-3,202 #VALUE!	2330 2332		1606.3 1614.8	3.7 8.5	10.3 7.6	6.0 3.2	5.1 2.9	5.0 3.0
151	Thu		7:00 AM	8,564.5	14,304.0	18.7	NA NA		NR NR		34	30	32	15	4	2	19	332	797.0	357,200	#VALUE!	2334	2250	1622.9	8.1	6.0	1.6	2.0	0.9
	Fri Sat	06/26/09 06/27/09	7:00 AM 8:00 AM	8,582.8 8,601.0	14,322.3 14,340.7	18.3 18.2	18.3 18.4		NR NR		32 33	31 30	31 30	15 15	1 3	1 3	17 18	330 330	1,143.2 1,489.9	346,200 346,700	315 316	2336 2338		1631.0 1639.1	8.1 8.1	5.7 4.5	2.2	2.8 4.0	2.8
	Sun		7:15 AM	8,619.8	14,340.7	18.2	18.4		NR NR		35	28	29	15	7	6	20	320	1,489.9	346,700	315	2338		1646.9	7.8	6.7	4.9	3.3	3.2
	Mor	06/29/09	NR	8,363.2	14,375.7	NA	16.2		NR		10	7	5	11	3	5	-1	0	2,000.7	155,400	#VALUE!		2259	1650.9	4.0	8.2	8.0	5.5	5.5
	Tue		NR NR	NR 8,656.3	NR 14,398.4	NA NA	NA NA		NR NR		NR 37	NR 31	NR 21	NR 15	#VALUE!	#VALUE!	#VALUE!	NR 288	NR 2,272.4	#VALUE!	#VALUE!	NR 2372	2283	NR 1656.7	#VALUE!	NR 4.9	NR 16.8	NR 3.1	NR 5.5
152	Thu	07/02/09	NR	8,679.1	14,422.3	22.8	23.9		NR		39	37	15	15	2	24	24	227	2,592.8	320,400	229	2376	2283	1665.5	8.8	2.2	40.8	0.0	5.5
	Fri Sat	07/03/09	8:55 AM	NR 8,720.2	NR 14,464.4	NA NA	NA NA		NR NR		NR 33	NR 27	NR 30	NR 17	#VALUE!	#VALUE!	#VALUE! 16	NR 340	NR NR	#VALUE! #VALUE!	#VALUE!	NR 2382	NR 2285	NR 1682.1	#VALUE!	NR 5.4	NR 2.0	NR 4.1	0.0
	Sun		10:00 AM	8,740.5	14,486.0	20.3	21.6		NR		34	25	28	16	9	6	18	320	180.9	#VALUE!	#VALUE!	2384	2287	1690.6	8.5	8.0	5.4	3.6	3.7

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet (Continued)

																Pressure I	F:144i								Davi.	kwash			
									KMnO₄							Pressure i	rittration								Баск	kwasn	Since I	Last BW	
								KMnO <sub>4</sub>	Tank 2	Estimated											Daily					Run	Run	Standby	Standby
				Tank A Hour		TA Run	TB Run	Tank 1	Level	KMnO₄		Outlet	Outlet				Inlet-	Flow	Totalizer to	Gallon	Average	Tank	Tank	Total	Daily	Time	Time	Time	Time
Week No.	Day of Week	Date	Time	Meter hrs	Meter hrs	Time	Time hrs	Level <sup>(a)</sup> inches	(Iron) inches	Dosage µg/L as Mn	Influent psig	Tank A psig	Tank B psig	Effluent	Inlet-TA psig	Inlet-TB psig	Effluent psig	gpm	Distribution kgal	Usage	Flowrate	A No.	B No.	Volume kgal	Volume kgal	Tank A hrs	Tank B hrs	Tank A hrs	Tank B hrs
NO.	Mon	07/06/09	8:00 AM	8.757.5	14,501.7	17.0	15.7	IIICIIGO	NR	µg/L as mil	34	26	28	15	8 8	6 6	19	321	507.5	326,600	333	2386	2289	1698.3	7.7	8.4	5.4	2.7	2.7
	Tue	07/07/09	7:00 AM	8,775.2	14,519.2	17.7	17.5		NR		32	32	27	15	0	5	17	342	848.3	340,800	323	2389	2292	1709.4	11.1	0.4	4.2	0.0	4.0
153	Wed	07/08/09	7:00 AM 7:00 AM	8,792.4 8,806.5	14,536.6 14,550.9	17.2 14.1	17.4 14.3		NR NR		33 41	34 37	27 31	15 15	-1 4	6 10	18 26	340 196	1,178.0 1,386.3	329,700 208,300	318 244	2391	2294	1717.9 1723.6	8.5 5.7	0.4	5.2 8.1	0.0	3.5 2.9
155	Fri	07/10/09	7:00 AM	8,825.6	14,569.6	19.1	18.7		NR		34	32	29	16	2	5	18	349	1,744.2	357,900	316	2395	2298	1733.6	10.0	1.7	3.8	0.0	1.9
	Sat	07/11/09	9:30 AM	8,845.7	14,589.4	20.1	19.8		NR		43	49	38	14	-6	5	29	186	2,127.4	383,200	320	2397	2302	1745.7	12.1	0.0	0.6	0.0	0.0
	Sun	07/12/09	11:00 AM 7:00 AM	8,867.2 8,883.9	14,611.2 14,627.9	21.5 16.7	21.8 16.7		NR NR		35 35	31 32	28 28	15 15	3	7	20	328 329	2,524.9 2,837.4	397,500 312,500	306 312	2400 2402	2304	1754.8 1762.6	9.1 7.8	3.6 2.6	6.1 7.5	0.0 1.3	0.8 1.4
	Tue	07/14/09	7:00 AM	8,900.3	14,649.5	16.4	21.6		NR		35	31	28	15	4	7	20	322	3,198.0	360,600	322		2309	1768.3	5.7	5.5	7.2	0.5	0.5
	Wed	07/15/09	7:00 AM	8,917.8	14,667.0	17.5	17.5		NR		34	30	31	15	4	3	19	320	262.8	-2,935,200	-2,795	2407	2312	1777.7	9.4	6.4	1.3	3.5	0.5
154	Thu	07/16/09	7:00 AM 7:00 AM	8,935.7 8.953.6	14,684.9 14,702.6	17.9 17.9	17.9 17.7		NR NR		34 33	32 34	28 32	15 15	-1	6	19 18	310 322	592.2 914.6	329,400 322,400	307 302	2409	2314	1785.5 1795.4	7.8 9.9	5.0 2.2	6.7 0.9	3.4 1.6	3.4 0.6
	Sat	07/18/09	7:30 AM	8,970.6	14,719.2	17.0	16.6		NR		43	44	42	15	-1	1	28	119	1,219.5	304,900	303	2412		1801.7	6.3	8.9	3.1	5.9	2.9
	Sun	07/19/09	7:30 AM	8,987.2	14,735.8	16.6	16.6		NR		42	44	41	15	-2	1	27	123	1,519.8	300,300	302	2414		1809.8	8.1	4.4	5.3	5.6	5.5
	Mon	07/20/09	7:00 AM 7:00 AM	9,004.1 9.022.3	14,753.2 14,764.4	16.9 18.2	17.4 11.2		NR NR		42 34	45 30	41 31	0 15	-3 4	3	42 19	108 311	1,819.2 2,133.2	299,400 314,000	291 377	2416 2417		1818.1 1823.6	8.3 5.5	0.5 8.6	2.2 0.3	0.0 4.0	2.1 0.0
	Wed	07/22/09	7:00 AM	9,039.1	14,785.2	16.8	20.8		NR		42	40	39	0	2	3	42	108	2,421.7	288,500	259	2418	2332	1826.0	2.4	12.9	2.3	5.7	1.9
155	Thu	07/23/09	7:00 AM	9,056.0	14,802.1	16.9	16.9		NR		33	33	30	15	0	3	18	334	2,727.2	305,500	301	2420		1835.2	9.2	3.0	1.9	1.8	0.4
	Fri Sat	07/24/09	8:10 AM NR	9,075.0 9.091.5	14,818.2 14.834.5	19.0 16.5	16.1 16.3		NR NR		33 33	35 32	27 28	15 16	-2 1	6 5	18 17	330 315	3,049.7 3.380.1	322,500 330,400	308 336	2422		1841.2 1859.1	6.0 17.9	0.2	7.1 6.5	0.0	3.6 2.9
	Sun	07/26/09	7:00 AM	9,108.7	14,851.5	17.2	17.0		NR		33	33	27	15	0	6	18	320	386.9	-2,993,200	-2,917	2425	2340	1855.5	-3.6	2.0	7.7	0.6	4.6
	Mon	07/27/09	7:00 AM	9,121.0	14,863.0	12.3	11.5		NR NR		33	32	31	15	1	2	18 -5	322	6,230.0	5,843,100	8,193	2426		1861.9	6.4	4.7	2.3	6.1 7.5	4.2
	Tue	07/28/09 07/29/09	6:50 AM 6:55 AM	9,132.3 9.146.0	14,874.8 14.888.5	13.7	11.8 13.7		NR NR		33	10 34	11 30	10 16	-5 -1	-6 3	-5 17	0 318	837.0 1,093.6	-5,393,000 256,600	-7,786 312	2427 2429		1866.0 1874.3	4.1 8.3	6.5 0.9	5.2 3.6	0.8	6.8 4.7
156	Thu	07/30/09	7:00 AM	9,159.9	14,902.2	13.9	13.7		NR		6	11	10	10	-5	-4	-4	0	1,351.7	258,100	312	2430	2347	1880.7	6.4	5.7	1.5	6.0	2.8
	Fri	07/31/09	7:00 AM	9,173.7	14,916.2	13.8	14.0		NR NR		33	34	27	15	-1 1	6	18	323	1,606.0	254,300	305		2348	1887.1	6.4	0.6	7.2	0.0	5.8
	Sat	08/01/09	8:00 AM 9:00 AM	9,191.9 9,207.4	14,934.0 14,949.3	18.2 15.5	17.8 15.3		NR NR		33 41	32 34	32 1	15 13	7	40	18 28	320 185	1,939.6 2,221.4	333,600 281,800	309 305	2434		1896.6 1900.7	9.5 4.1	2.2 7.5	1.2	0.0 5.7	0.0
	Mon	08/03/09	7:10 AM	9,220.2	14,962.2	12.8	12.9	NR	NR	NA	7	12	11	10	-5	-4	-3	0	2,457.0	235,600	306	2437	2354	1909.0	8.3	2.9	4.3	4.0	4.0
	Tue	08/04/09	7:05 AM	9,234.8	14,976.5	14.6	14.3	NR	NR	NA	34	30	32	15	7	2	19	320	2,721.6	264,630	305	2438	2356	1914.7	5.7	9.3	2.2	5.3	2.1
157	Wed	08/05/09	7:10 AM 7:05 AM	9,253.2 9,269.8	14,995.1 15,011.5	18.4 16.6	18.6 16.4	NR NR	NR NR	NA NA	35 35	28 29	31 33	15 15	6	4	20	308 328	3,057.7 87.0	336,070 87.000	303 88	2440	2358	1922.6 1932.8	7.9 10.2	9.0 8.3	4.0 0.7	4.1 3.4	3.5 0.0
1	Fri	08/07/09	7:05 AM	9,291.0	15,032.6	21.2	21.1	NR	NR	NA	33	33	31	15	0	2	18	324	436.6	349,600	275	2445	2364	1945.3	12.5	2.6	2.1	0.0	0.0
	Sat	08/08/09	9:00 AM	NR 9,328.8	NR 15.069.9	NA NA	NA NA	NR NR	NR NR	NA NA	NR 23	NR 22	NR 22	NR 16	NA 1	NA 1	NA 7	NR 230	NR 1 094 0	NA NA	#VALUE!	NR 2450	NR 2371	NR 1968.8	NA NA	NR 6.4	NR 1.5	NR 3.4	NR 0.0
	Mon	08/10/09	7:25 AM	9,344.3	15,009.9	15.5	15.6	NR	NR	NA NA	34	32	31	16	2	3	18	305	1,381.8	287.800	308	2452	2373	1977.1	8.3	4.4	3.8	4.4	4.4
	Tue	08/11/09	7:00 AM	9,360.6	15,101.7	16.3	16.2	NR	NR	NA	33	33	32	15	0	1	18	325	1,666.6	284,800	292	2454	2376	1981.3	4.2	2.4	0.8	3.6	0.5
158	Wed Thu	08/12/09 08/13/09	10:55 AM 6:48 AM	9,375.8 9,393.7	15,116.6 15,134.2	15.2 17.9	14.9 17.6	NR NR	NR NR	NA NA	34 33	32 34	32 33	15 16	2	0	19 17	322 326	1,943.7 2,263.2	277,100 319,500	307 300	2456 2459		1997.9 2012.3	16.6 14.4	4.0 1.1	0.8	4.4 0.0	0.6
136	Fri	08/14/09	7:00 AM	9,413.6	15,153.3	19.9	19.1	NR	NR	NA NA	34	28	32	15	6	2	19	320	2,605.8	342,600	293	2461	2387	2012.3	12.5	6.7	0.1	2.9	0.0
	Sat	08/15/09	7:30 AM	9,431.5	15,171.1	17.9	17.8	NR	NR	NA	32	33	31	15	-1	1	17	327	2,924.6	318,800	298	2465	2391	2041.3	16.5	8.0	1.3	0.6	0.6
-	Sun	08/16/09	7:30 AM	9,448.0	15,187.4 15.204.6	16.5 17.2	16.3 17.2	NR NR	NR NR	NA NA	35 35	29 30	32 32	15 15	6	3	20	309 305	3,216.9 243.5	292,300	297 236	2466	2393	2047.1 2055.1	5.8 8.0	8.2 7.4	2.4	4.9	1.0 2.5
	Tue	08/18/09	7:15 AM	9,479.9	15,219.9	14.7	15.3	NR	NR	NA	34	32	30	15	2	4	19	308	506.8	263,300	293	2470	2397	2064.2	9.1	4.6	3.8	5.0	5.0
	Wed	08/19/09	6:55 AM	9,497.7	15,234.2	17.8	14.3	NR	NR	NA	34	34	30	15	0	4	19	314	774.4	267,600	281	2472		2072.5	8.3	2.0	3.5	6.0	4.6
159	Thu Fri	08/20/09	7:00 AM 7:00 AM	9,508.7 9.522.5	15,247.9 15,261.4	11.0	13.7	NR NR	NR NR	NA NA	35 34	30	29 33	15 15	5	6	20 19	298 323	1,023.1	248,700 246,500	340 301	2473	2401	2078.6 2089.2	6.1 10.6	7.2	6.0 0.1	4.4	4.3 0.0
	Sat	08/22/09	7:30 AM	9,533.7	15,272.6	11.2	11.2	NR	NR	NA	34	33	31	15	1	3	19	300	1,482.8	213,200	317	2476	2405	2093.4	4.2	5.3	4.8	7.0	7.1
	Sun	08/23/09	10:00 AM	9,552.4	15,291.0	18.7	18.4	NR	NR	NA	35	30	33	15	5	2	20	298	1,798.2	315,400	283	2478	2408	2104.0	10.6	9.5	3.3	6.4	0.0
	Mon	08/24/09 08/25/09	7:00 AM 7:00 AM	9,564.4 9,580.9	15,303.4 15,319.7	12.0 16.5	12.4 16.3	NR NR	NR NR	NA NA	36 34	36 35	29 33	15 15	0 -1	7	21 19	304 315	2,017.0 2,303.7	218,800 286,700	299 291	2480	2409	2110.0 2120.7	6.0 10.7	0.9	0.0	0.0	0.0
	Wed	08/26/09	7:10 AM	9,602.5	15,341.1	21.6	21.4	NR	NR	NA	35	31	33	15	4	2	20	315	2,664.5	360,800	280	2484	2415	2130.5	9.8	5.9	1.5	1.6	0.4
160	Thu	08/27/09	7:15 AM 7:15 AM	9,620.5 9,640.4	15,359.4 15,379.4	18.0 19.9	18.3 20.0	NR NR	NR NR	NA NA	36 41	30 39	29 1	15 15	6	7	21 26	294 193	2,979.6 47.9	315,100 47,900	289 40	2486 2489		2139.2 2150.6	8.7 11.4	7.7	3.3 1.4	7.1	3.2
	Sat	08/29/09	V: 15 AW	9,040.4 NR	15,379.4 NR	NA NA	NA	NR NR	NR NR	NA NA	NR	NR	NR	NR	NA	NA NA	NA	NR	NR	47,900 NA	#VALUE!	2469 NR	2420 NR	2150.6 NR	NA	NR	NR	NR	NR
	Sun	08/30/09	9:40 AM	9,677.8	15,416.5	NA	NA	NR	NR	NA	37	31	32	15	6	5	22	280	681.9	NA	#VALUE!	2493		2172.2	NA	7.2	3.9	6.2	4.1
	Mon	08/31/09	7:15 AM 7:00 AM	9,694.4 9,714.4	15,432.6 15,452.8	16.6 20.0	16.1 20.2	NR NR	NR NR	NA NA	37 35	31	36 33	15 15	6	1 2	22	280 310	958.3 1.296.0	276,400 337,700	282 280	2495	2429	2182.1 2195.0	9.9 12.9	7.3	4.0 1.9	1.5 0.7	0.0
	Wed	09/02/09	7:00 AM	9,714.4	15,452.6	19.3	19.2	NR NR	NR NR	NA NA	35	32	33	15	3	2	20	312	1,611.3	315,300	273	2500		2205.2	10.2	5.5	2.3	2.3	0.8
161	Thu	09/03/09	7:00 AM	9,752.6	15,491.1	18.9	19.1	NR	NR	NA	36	36	31	15	0	5	21	309	1,935.4	324,100	284	2503	2438	2217.8	12.6	0.7	4.0	0.0	0.8
	Fri Sat	09/04/09	7:10 AM 7:30 AM	9,769.4 9,784.5	15,507.8 15,522.1	16.8 15.1	16.7 14.3	NR NR	NR NR	NA NA	41 37	42 31	4 36	15 15	-1 6	37	26 22	189 305	2,214.9 2,470.0	279,500 255,100	278 289	2505 2506	2441	2227.2 2237.5	9.4 10.3	7.3	0.0	0.0 6.3	0.0
	Sun	09/06/09	7:20 AM	9,800.1	15,537.3	15.6	15.2	NR	NR	NA NA	35	31	34	15	4	1	20	307	2,736.4	266,400	288		2448	2247.7	10.2	7.8	0.3	6.9	1.1
	Mon	09/07/09	7:30 AM	9,815.0	15,551.7	14.9	14.4	NR	NR	NA	36	30	34	15	6	2	21	293	2,991.9	255,500	291	2510	2451	2258.3	10.6	5.6	1.0	6.4	1.2
	Tue	09/08/09	6:55 AM 7:00 AM	9,831.6 9,846.7	15,568.0 15,582.8	16.6 15.1	16.3 14.8	NR NR	NR NR	NA NA	37 36	31	31 30	15 15	6	6	22	287 286	3,276.2 259.5	284,300 259.500	288 289	2512 2514	2454 2457	2268.9 2279.2	10.6 10.3	6.6 4.7	4.2 4.1	3.1 4.4	4.1
162	Thu	09/09/09	7:00 AM	9,861.3	15,562.6	14.6	14.0	NR NR	NR NR	NA NA	41	42	4	15	-1	37	26	194	509.1	249,600	289	2514	2460	2289.4	10.3	1.2	0.6	0.0	0.0
	Fri	09/11/09	7:10 AM	9,875.9	15,610.7	14.6	13.7	NR	NR	NA	36	30	36	15	6	0	21	294	754.5	245,400	289	2517	2464	2299.3	9.9	9.9	4.5	0.3	0.0
	Sat	09/12/09	8:00 AM 8:00 AM	9,888.8 9,904.2	15,623.6 15,630.4	12.9 15.4	12.9 6.8	NR NR	NR NR	NA NA	44 35	44 35	41 32	15 15	0	3	29	200 295	983.3 1,245.4	228,800 262,100	296 463	2519 2521	2466	2307.9 2319.4	8.6 11.5	4.5 2.5	3.9 1.9	5.7 2.3	5.8 2.3
	Mon	09/14/09	7:05 AM	9,919.6	15,653.1	15.4	22.7	NR	NR	NA NA	43	21	37	14	22	6	29	168	1,469.9	224,500	204	2522		2328.1	8.7	0.0	0.0	2.7	4.0
	Tue	09/15/09	7:15 AM	9,935.9	15,668.6	16.3	15.5	NR	NR	NA	37	32	33	15	5	4	22	283	1,768.4	298,500	313	2524	2477	2342.2	14.1	6.9	1.8	5.0	2.2
163	Wed Thu	09/16/09	7:15 AM 7:10 AM	9,950.6 9,965.3	15,683.1 15,697.0	14.7	14.5 13.9	NR NR	NR NR	NA NA	36 43	35 36	30 4	15 13	7	6 39	21 30	303 171	2,027.0 2,267.3	258,600 240,300	295 280	2526 2527	2480 2483	2350.8 2359.1	8.6 8.3	6.7 9.4	5.9 4.5	4.9 0.0	5.0 0.0
100	Fri	09/18/09	7:30 AM	9,980.0	15,711.2	14.7	14.2	NR	NR	NA	36	35	33	15	1	3	21	309	2,516.8	249,500	288	2529		2373.5	14.4	4.1	1.3	3.3	0.6
	Sat	09/19/09	NR	NR	NR	NA	NA	NR	NR	NA	NR	NR	NR	NR	NA	NA	NA	NR	NR	NA	#VALUE!	NR	NR	NR	NA	NR	NR	NR	NR
	Sun	09/20/09	NR	NR	NR	NA	NA	NR	NR	NA	NR	NR	NR	NR	NA	NA	NA	NR	NR	NA	#VALUE!	NK	NR	NR	NA	NR	NR	NR	NR

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet (Continued)

												1	1	1		Pressure I	Filtration								Back	wash	Since L	DW	
								KMnO₄	KMnO₄ Tank 2	Estimated											Daily				-	Run			Standby
				Tank A Hour	Tank B Hour	TA Run	TB Run	Tank 1	Level	KMnO <sub>4</sub>		Outlet	Outlet				Inlet-	Flow	Totalizer to	Gallon	Average	Tank	Tank	Total	Daily	Time	Time	Time	Time
Week	Day of			Meter	Meter	Time	Time	Level <sup>(a)</sup>	(Iron)	Dosage	Influent	Tank A	Tank B	Effluent	Inlet-TA	Inlet-TB	Effluent	rate	Distribution	Usage	Flowrate	Α	В	Volume	Volume		Tank B	Tank A	Tank B
No.	Week	Date	Time	hrs	hrs	hrs	hrs	inches		μg/L as Mn	psig	psig	psig	psig	psig	psig	psig	gpm	kgal	gal	gpm	No.	No.	kgal	kgal	hrs	hrs	hrs	hrs
	Mon Tue	09/21/09	7:15 AM 7:25 AM	10,021.8 10.036.0	15,751.6 15,765.3	NA 14.2	13.7	NR NR	NR NR	NA NA	6	12	9 11	10	-6 -5	-3 -5	-4 -4	0	3,029.7 7.2	7,200	#VALUE!	2532 2533	2495 2498	2393.2 2401.2	8.0	2.1 7.7	7.8 2.8	4.6 4.9	6.9 3.6
	Wed	09/23/09	7:15 AM	NR	NR	NA	NA	NR	NR	NA	37	36	36	16	1	1	21	324	266.1	258,900	#VALUE!	2535	2501	2411.8	10.6	6.7	0.8	5.2	0.0
164	Thu Fri	09/24/09	7:00 AM	10,065.6	15,794.1	NA	NA	NR	NR NR	NA	39	33	32	15	6 5	7	24	291	523.8	257,700	#VALUE!	2536		2417.9	6.1	9.4	3.5	5.1	4.6
	Sat	09/25/09	7:00 AM 6:30 AM	10,081.0 10.100.6	15,808.8 15.826.2	15.4 19.6	14.7 17.4	NR NR	NR NR	NA NA	39 38	34 38	33 35	15 15	0	3	24 23	293 304	786.2 1.110.1	262,400 323,900	291 293	2538 2541	2508	2431.5 2456.1	13.6 24.6	6.4 1.9	1.9 0.9	4.2	2.5 0.0
	Sun	09/27/09	8:00 AM	10,120.9	15,845.5	20.3	19.3	NR	NR	NA	38	34	32	15	4	6	23	290	1,446.8	336,700	284	2543	2522	2470.5	14.4	6.0	4.2	3.2	3.3
	Mon	09/28/09	7:05 AM	10,141.4	15,865.9	20.5 16.7	20.4	NR NR	NR	NA NA	38 38	39	33	15	-1	5	23	299	1,788.0	341,200	278 271	2546 2548		2484.9 2494.8	14.4	1.6	3.4	0.0	1.2
	Tue	09/29/09	7:00 AM 7:00 AM	10,158.1 10.175.3	15,882.6 15,899.4	17.2	16.7 16.8	NR	NR NR	NA NA	38	39 38	37 38	15 15	0	0	23	300 284	2,060.0 2,337.0	272,000 277,000	272	2550		2502.8	9.9 8.0	1.1	1.5	0.0	0.0
165	Thu	10/01/09	8:00 AM	10,191.3	15,915.4	16.0	16.0	NR	NR	NA	38	39	39	15	-1	-1	23	295	2,597.7	260,700	272	2552	2533	2511.1	8.3	1.2	0.1	6.0	0.0
	Fri Sat	10/02/09	8:00 AM MA 00:8	10,206.4 10.220.9	15,930.7 15,945.1	15.1	15.3	NR NR	NR	NA NA	38 38	38 38	38 38	15 15	0	0	23	295	2,846.4 3.090.9	248,700 244,500	273 282	2554 2556	2535	2519.5 2527.8	8.4 8.3	1.7	0.7 1.6	0.0	0.0 1.9
	Sun	10/03/09	8:00 AM	10,220.9	15,945.1	14.3	14.4	NR NR	NR NR	NA NA	38	38	37	15	0	1	23	295 293	47.6	47,600	55	2558		2536.6	8.8	2.3	1.5	3.4	2.0
	Mon	10/05/09	7:15 AM	NR	NR	NA	NA	NR	NR	NA	39	34	34	15	5	5	24	280	283.5	235,900	#VALUE!	2559		2540.7	4.1	11.1	10.7	6.0	6.1
	Tue	10/06/09	7:10 AM 7:15 AM	10,263.3 10,275.7	15,987.7 15,999.9	12.4	12.2	NR NR	NR NR	NA NA	39 44	36 4	35 39	15 15	3 40	- 4 - 5	24 29	283	505.3 719.6	221,800	#VALUE! 290	2561	2542	2549.1 2560.1	8.4 11.0	5.6 0.0	5.3 2.1	4.2 0.0	4.2 2.9
166	Thu	10/08/09	6:15 AM	10,288.7	16,013.2	13.0	13.3	NR	NR	NA NA	38	40	37	15	-2	1	23	287	940.6	221,000	280	2566		2574.5	14.4	0.2	1.4	0.0	1.3
	Fri	10/09/09	7:00 AM	10,305.4	16,028.8	16.7	15.6	NR	NR	NA	38	39	36	15	-1	2	23	291	1,199.5	258,900	267	2568	2553	2586.6	12.1	1.3	1.7	0.0	0.0
	Sat	10/10/09	7:50 AM 10:30 AM	10,320.7 10.338.5	16,043.3 16.061.0	15.3 17.8	14.5 17.7	NR NR	NR NR	NA NA	39 39	39 40	37 37	15 15	0	2	24 24	297 289	1,440.5 1,733.5	241,000 293,000	270 275	2570 2573		2598.7 2613.5	12.1 14.8	2.0 1.2	0.9 2.3	3.3 0.0	1.1 0.0
	Mon	10/12/09	6:50 AM	10,350.9	16,073.0	12.4	12.0	NR	NR	NR	38	38	36	15	0	2	23	281	1,931.2	197,700	270	2574		2619.5	6.0	6.9	5.7	0.7	4.7
	Tue	10/13/09	7:00 AM 7:15 AM	10,366.2	16,087.9	15.3 16.4	14.9 15.7	NR NR	NR NR	NR NR	44 39	45	45	15	-1	-1 0	29	91	2,182.8 2.443.7	251,600	278 271	2576 2579	2566	2629.4 2648.3	9.9 18.9	5.2 4.4	1.7 0.1	4.9 4.4	0.0
167	Wed	10/14/09	7:15 AM	10,382.6 10.402.2	16,103.6 16.122.8	19.6	15.7	NR NR	NR NR	NR NR	39	36 38	39 38	15 15	1	1	24 24	288	2,443.7	260,900 308,700	265		2572 2576	2662.7	18.9	3.6	0.1	0.0	0.0
1.0	Fri	10/16/09	7:20 AM	10,422.3	16,143.1	20.1	20.3	NR	NR	NR	38	38	36	15	0	2	23	282	3,070.0	317,600	262		2579	2675.3	12.6	2.0	2.8	1.5	2.7
	Sat	10/17/09	8:45 AM 9:00 AM	10,440.7 10,458.0	16,161.0 16,178.4	18.4 17.3	17.9 17.4	NR NR	NR NR	NR NR	38 39	38 35	36 38	15 15	0	1	23 24	285 276	3,382.1 367.4	312,100 367,400	287 353		2581	2686.1 2696.1	10.8 10.0	6.7 3.9	5.9 2.3	1.0	4.3 0.0
	Mon	10/19/09	7:00 AM	10,456.0	16,176.4	11.6	17.4	NR	NR NR	NR NR	21	23	22	23	-2	-1	-2	0	396.6	29,200	40		2586	2696.1	0.0	9.7	9.8	6.8	6.9
	Tue	10/20/09	7:10 AM	10,484.1	16,205.2	14.5	14.3	NR	NR	NR	38	35	34	16	3	4	22	295	633.8	237,200	275	2596	2588	2704.4	8.3	4.0	7.1	4.6	4.7
168	Wed	10/21/09	7:15 AM 7:10 AM	10,498.4 10,513.2	16,220.0 16,234.4	14.3	14.8	NR NR	NR NR	NR NR	44 38	5 34	41 38	12 15	39	3	32 23	128 284	877.7 1,116.1	243,900 238,400	279 272	2598 2600	2590 2592	2712.4 2721.1	8.0 8.7	0.0 6.7	4.5 0.8	0.0 5.2	5.0 0.0
100	Fri	10/23/09	7:20 AM	10,513.2	16,250.9	16.3	16.5	NR	NR	NR	44	3	40	13	41	4	31	123	1,377.3	261,200	265	2602	2593	2727.2	6.1	0.0	7.9	0.0	6.0
	Sat	10/24/09	8:00 AM	10,547.5	16,269.4	18.0	18.5	NR	NR	NR	38	37	36	15	1	2	23	277	1,674.8	297,500	272	2605	2595	2737.8	10.6	2.9	2.1	7.3	4.7
-	Sun	10/25/09 10/26/09	7:00 AM 8:00 AM	10,565.5 10.581.0	16,287.9 16,303.2	18.0 15.5	18.5 15.3	NR NR	NR NR	NR NR	39 38	40 38	36 38	15 15	-1 0	3	24 23	298 302	1,966.9 2,208.1	292,100 241.200	267 261	2608 2610	2597	2748.7 2757.1	10.9 8.4	0.1 1.0	0.0	5.9 0.0	4.8 0.0
	Tue	10/27/09	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	#VALUE!	#VALUE!	#VALUE!	NR	NR	#VALUE!	#VALUE!	NR	NR	NR	#VALUE!	NR	NR	NR	NR
169	Wed	10/28/09	NR NR	NR NR	NR NR	NA NA	NA NA	NR NR	NR NR	NR NR	NR NR	NR NR	NR NR	NR NR	#VALUE!	#VALUE!	#VALUE!		NR NR	#VALUE! #VALUE!	#VALUE!	NR NR	NR NR	NR NR	#VALUE!	NR NR	NR NR	NR NR	NR NR
109	Fri	10/29/09	8:00 AM	10,623.2	16,345.1	NA NA	NA NA	NR	NR NR	NR NR	16	10	6	17	#VALUE!	#VALUE!	#VALUE!	NR NR	2,889.0	#VALUE!	#VALUE!		2608	2770.4	#VALUE!	4.3	5.4	3.3	3.3
	Sat	10/31/09	7:00 AM	10,635.8	16,355.1	12.6	10.0	NR	NR	NR	33	31	25	16	2	8	17	366	3,084.9	195,900	293	2622	2622	2774.2	3.8	2.9	7.6	4.2	4.2
-	Sun	11/01/09	8:00 AM 7:00 AM	10,648.9 10,660.0	16,368.2 16,380.1	13.1	13.1 11.9	NR NR	NR NR	NR NR	33 35	28 27	25 27	15 15	5 8	8 8	18 20	348 326	75.0 325.4	75,000 250,400	95 363	2623 2624	2623	2778.4 2782.6	4.2 4.2	5.5 7.1	10.6 8.9	6.4 7.6	10.5 8.3
	Tue	11/03/09	8:00 AM	10,673.7	16,343.5	13.7	-36.6	NR	NR	NR	8	11	11	10	-3	-3	-2	0	606.5	281,100	107	2626		2791.3	8.7	4.6	3.4	5.9	4.7
	Wed	11/04/09	7:00 AM	10,684.2	16,404.1	10.5	60.6	NR	NR	NR	8	11	11	10	-3	-3	-2	0	833.3	226,800	211	2628	2627	2797.7	6.4	0.8	5.6	0.1	5.8
170	Thu Fri	11/05/09	7:20 AM 7:30 AM	10,696.0	16,415.8 16,427.2	11.8 11.3	11.7 11.4	NR NR	NR NR	NR NR	8 8	11	10 10	10 10	-3	-2 -2	-2	0	1,107.8 1,379.0	274,500 271,200	389 398	2629 2630	2628	2801.9 2806.1	4.2 4.2	1.5 1.9	5.8 9.0	1.3	6.6 7.9
	Sat	11/07/09	7:00 AM	10,717.7	16,437.7	10.4	10.5	NR	NR	NR	41	39	39	10	2	2	31	241	1,642.5	263,500	420	2631	2631	2811.8	5.7	4.4	2.7	6.4	3.0
	Sun	11/08/09	7:00 AM 7:00 AM	10,727.7 10,739.7	16,447.9 16,459.5	10.0	10.2 11.6	NR NR	NR NR	NR NR	8 28	11 21	10 22	10 15	-3	-2 6	-2 13	409	1,894.2 2,184.2	251,700 290,000	415 410	2632	2632	2816.3 2822.8	4.5 6.5	4.9 7.9	6.6 3.2	7.9 3.1	9.3 6.2
	Tue	11/10/09	7:00 AM	10,739.7	16,459.5	10.4	10.5	NR	NR NR	NR NR	29	22	21	15	7	8	14	393	2,164.2	262,200	418	2634		2826.9	4.1	7.9	6.2	8.3	6.6
	Wed	11/11/09	9:30 AM	10,760.3	16,479.8	10.2	9.8	NR	NR	NR	29	21	22	15	8	7	14	410	2,716.2	269,800	450	2636	2637	2835.3	8.4	1.1	4.9	1.7	8.8
171	Thu Fri	11/12/09	7:00 AM 7:30 AM	10,769.0 10,774.5	16,488.2 16.498.0	8.7 5.5	8.4 9.8	NR NR	NR NR	NR NR	7 25	10 24	6 21	10 15	-3 1	4	-3 10	434	2,932.2 3,197.2	216,000 265,000	421 627	2637	2639	2841.4 2850.1	6.1 8.7	1.9 0.8	2.5 3.5	5.8 0.0	6.4 4.2
	Sat	11/14/09	7:30 AM	10,788.4	16,507.0	13.9	9.0	NR	NR	NR	25	22	23	15	3	2	10	445	159.9	159,900	244	2640	2643	2856.2	6.1	3.6	1.1	6.9	2.0
	Sun	11/15/09	7:30 AM	10,800.3	16,519.1	11.9	12.1	NR	NR	NR	27	23	21	15	4	6	12	430	464.5	304,600	423	2642		2864.2	8.0	3.1	3.9	6.1	7.2
	Mon Tue	11/16/09	7:00 AM 7:15 AM	10,811.5 10.828.7	16,529.6 16,546.9	11.2 17.2	10.5 17.3	NR NR	HR NR	NR NR	26 19	23 17	23 14	15 15	3	3 5	11	450 257	738.7 1,007.2	274,200 268.500	422 259	2644	2648	2874.4 2878.6	10.2 4.2	2.3	0.5 8.4	3.8	0.6 3.0
	Wed	11/18/09	7:15 AM	10,846.8	16,564.9	18.1	18.0	NR	NR	NR	18	15	17	15	3	1	3	265	1,283.3	276,100	255	2646		2884.7	6.1	8.0	1.0	3.1	0.0
172	Thu	11/19/09	7:15 AM	10,858.1	16,576.0	11.3	11.1	NR	NR	NR	8	10	9	11	-2	-1	-3	0	1,563.5	280,200	417	2648		2893.0	8.3	5.5	3.4	3.7	5.1
	Fri Sat	11/20/09	7:30 AM 7:30 AM	10,868.6 10,879.0	16,587.0 16,599.8	10.5 10.4	11.0 12.8	NR NR	NR NR	NR NR	35	10 44	27	10 15	-2 -9	8	-2 20	318	1,835.9 2 097 4	272,400 261,500	423 380	2650 2651	2655 2657	2901.4 2909.5	8.4 8.1	3.4	2.6	5.8	4.5 4.9
	Sun	11/22/09	7:45 AM	10,889.9	16,608.3	10.9	8.5	NR	NR	NR	8	9	7	10	-1	1	-2	0	2,359.2	261,800	457	2653		2916.2	6.7	8.5	2.4	5.1	2.9
	Mon	11/23/09	7:00 AM	10,900.4	16,618.8	10.5	10.5	NR	NR	NR	7	9	6	10	-2 2	1 5	-3	0	2,631.2	272,000	432	2654		2922.3	6.1	6.2	2.7	8.9	6.1
	Tue	11/24/09	7:30 AM 7:30 AM	10,911.6 10,922.3	16,629.7 16,640.0	11.2 10.7	10.9 10.3	NR NR	NR NR	NR NR	26 26	24 22	21 22	15 15	4	4	11	432 423	2,906.6 3,169.5	275,400 262,900	415 417	2656 2657	2663 2665	2930.7 2937.1	8.4 6.4	1.9 4.7	2.8	4.0 6.1	6.2 5.0
173	Thu	11/26/09	9:00 AM	10,933.1	16,644.7	10.8	4.7	NR	NR	NR	27	21	22	15	6	5	12	425	NR	#VALUE!	#VALUE!	2659	2667	2944.2	7.1	3.6	2.0	2.8	2.3
	Fri Sat	11/27/09	9:00 AM 11:30 AM	10,944.0 10.955.8	16,661.6 16.673.4	10.9	16.9 11.8	NR NR	NR NR	NR NR	27 26	22	23	15 15	5	4	12	430 426	441.6 736.2	441,600 294.600	555 416	2660 2662	2669 2671	2951.5 2959.9	7.3 8.4	5.4 3.7	2.0	8.2 3.0	4.0 1.3
	Sun	11/29/09	9:00 AM	10,955.8	16,681.4	8.2	8.0	NR NR	NR	NR NR	27	22	21	15	5	6	12	411	952.1	215,900	444	2663	2672	2959.9	4.2	5.3	3.9	9.2	8.2
	Mon	11/30/09	6:25 AM	10,973.4	16,690.4	9.4	9.0	NR	NR	NR	27	21	22	15	6	5	12	427	1,185.2	233,100	422			2970.2	6.1	7.0	2.8	9.1	6.7
	Tue Wed	12/01/09 12/02/09	7:00 AM 7:00 AM	10,984.6 10.995.8	16,701.9 16,717.5	11.2	11.5 15.6	NR NR	NR NR	NR NR	26 26	25 22	22	18 16	1 4	3	8 10	430 440	1,476.1 1,740.7	290,900 264.600	427 338	2667 2667	2677	2982.3 2986.2	12.1 3.9	0.3 11.6	2.6	0.0 11.5	4.9 1.1
174	Thu	12/03/09	7:00 AM	11,007.6	16,724.7	11.8	7.2	NR	NR	NR	26	24	24	17	2	2	9	409	2,018.2	277,500	517	2669	2681	2994.6	8.4	4.4	2.5	6.5	5.2
	Fri	12/04/09	7:00 AM	11,011.1	16,735.6	3.5	10.9	NR	NR	NR	25	24	22	17	1	3	8	449	2,308.9	290,700	914	2672	2685	3009.0	14.4	0.3	0.0	1.2	0.5
	Sat	12/05/09	8:00 AM 8:00 AM	11,033.7 11,050.9	16,749.5 16,766.5	22.6 17.2	13.9 17.0	NR NR	NR NR	NR NR	21 15	17 15	20 14	14	4 0	1	1	330 266	2,637.9 2.975.8	329,000 337,900	319 329	2679 2682	2693 2697	3039.7 3054.2	30.7 14.5	0.0 4.9	5.0	1.0 3.3	0.0 5.0
	Jun	12000	U.UU MIVI	11,000.0	10,100.0	11.2			1.417	1417		,							E,010.0	001,000	020	-502	-501	UUUT.2	11.0	7.0	0.0	0.0	0.0

Table A-1. US EPA Arsenic Demonstration Project at Arnaudville, LA - Daily System Operation Log Sheet (Continued)

																													$\neg$
									KMnO₄			1		1		Pressure	Filtration						1		Back	wash	Since L	aet RW	
								KMnO₄	Tank 2	Estimated											Daily				•	Run			Standby
l	l			Tank A Hour		TA Run	TB Run	Tank 1	Level	KMnO <sub>4</sub>		Outlet	Outlet				Inlet-	Flow	Totalizer to	Gallon	Average	Tank	Tank	Total	Daily	Time	Time		Time
Week No.	Day of Week	Date	Time	Meter hrs	Meter hrs	Time hrs	Time hrs	Level <sup>(a)</sup> inches	(Iron) inches	Dosage µg/L as Mn	Influent	Tank A psig	Tank B psig	Effluent psig	Inlet-TA psig	Inlet-TB psig	Effluent psig	gpm	Distribution kgal	Usage gal	Flowrate gpm	A No.	B No.	Volume kgal	Volume kgal	Tank A hrs	Tank B hrs	Tank A 1	Tank B hrs
	Mon	12/07/09	7:00 AM	11,068.8	16,784.8	17.9	18.3	NR	NR	NR	15	15	14	14	0	1	1	262	33.7	33,700	31	2685	2701	3068.6	14.4	3.9	3.1	0.3	0.0
	Tue Wed	12/08/09 12/09/09	6:50 AM 7:00 AM	11,081.8 11.093.0	16,797.3 16.808.4	13.0 11.2	12.5 11.1	NR NR	NR NR	NR NR	8 25	11 25	23	15 16	-3 0	6 2	-7 9	448	347.4 646.9	313,700 299,500	410 448	2687 2689	2702 2706	3074.6 3086.8	6.0 12.2	6.7 0.0	6.6 0.0	0.0	0.0
175	Thu	12/10/09	7:00 AM	11,106.2	16,820.9	13.2	12.5	NR	NR	NR	26	23	22	17	3	4	9	412	986.8	339,900	441	2691	2710	3098.6	11.8	3.6	0.0	2.1	3.0
	Fri Sat	12/11/09 12/12/09	7:00 AM 10:00 AM	11,118.9 11,131.1	16,833.0 16,844.9	12.7 12.2	12.1 11.9	NR NR	NR NR	NR NR	8	10 10	8 8	10 10	-2 -2	0	-2 -2	0	1,285.6 1,601.3	298,800 315,700	402 437	2694 2696	2715 2718	3114.5 3124.8	15.9 10.3	1.8 3.4	0.9 4.1	1.9	0.3 1.6
	Sun	12/13/09	8:00 AM	11,142.3	16,855.5	11.2	10.6	NR	NR	NR	26	23	23	15	3	3	11	425	1,878.9	277,600	425	2698	2721	3135.0	10.2	2.1	2.4	1.1	0.7
	Mon Tue	12/14/09 12/15/09	7:00 AM 7:00 AM	11,158.7 11,170.7	16,871.8 16,883.6	16.4 12.0	16.3 11.8	NR NR	NR NR	NR NR	8 27	9 22	6 22	10 15	-1 5	5	-2 12	0 424	2,180.8 2,478.2	301,900 297,400	308 417	2702	2726 2728	3153.6 3159.7	18.6 6.1	0.7 6.1	0.0 4.1	1.8 5.9	0.9 4.9
	Wed	12/16/09	7:00 AM	11,183.3	16,895.5	12.6	11.9	NR	NR	NR	42	41	40	0	1	2	42	187	2,802.3	324,100	441	2705	2731	3169.9	10.2	4.7	4.0	6.2	6.0
176	Thu	12/17/09	7:00 AM 7:00 AM	11,196.0 11.207.6	16,908.2 16,919.4	12.7 11.6	12.7 11.2	NR NR	NR NR	NR NR	8	10	8	10 10	-2 -2	0	-2 -2	0	3,116.7 133.1	314,400 133,100	413 195	2707	2734 2737	3180.2 3190.4	10.3 10.2	3.7 2.2	3.0	5.8 2.9	5.8 4.4
	Sat	12/19/09	8:00 AM	11,219.1	16,930.5	11.5	11.1	NR	NR	NR	25	23	22	16	2	3	9	428	419.3	286,200	422		2740	3201.0	10.6	1.5	2.0	2.5	3.5
	Sun	12/20/09	10:00 AM 7:00 AM	11,233.9 11,242.7	16,944.2 16,953.8	14.8 8.8	13.7 9.6	NR NR	NR NR	NR NR	26 25	23 23	22	16 18	3	2	10 7	423 440	770.6 1,016.4	351,300 245,800	411 446	2713 2715	2743	3210.9 3221.5	9.9 10.6	3.6 1.7	2.9 0.2	3.0 2.0	1.8
	Tue	12/22/09	7:00 AM	11,254.1	16,965.2	11.4	11.4	NR	NR	NR	8	10	8	10	-2	0	-2	0	1,307.5	291,100	426	2717	2748	3230.7	9.2	1.1	3.5	1.2	5.9
177	Wed	12/23/09	7:00 AM 6:15 AM	11,266.5 11,279.1	16,976.8 16.988.7	12.4 12.6	11.6 11.9	NR NR	NR NR	NR NR	26 8	24 10	22 7	17 10	-2	1	-2	436	1,611.9 1,911.3	304,400 299,400	423 408	2719	2751 2754	3240.5 3250.7	9.8 10.2	1.7 0.6	2.7 3.5	2.5 1.2	4.6 5.5
	Fri	12/25/09	7:30 AM	11,291.9	17,001.5	12.8	12.8	NR	NR	NR	26	24	21	18	2	5	8	426	2,235.5	324,200	422	2723		3261.0	10.3	0.5	4.0	0.8	5.9
	Sat	12/26/09	6:15 AM 6:15 AM	11,306.3 11.322.4	17,015.9 17.031.9	14.4 16.1	14.4 16.0	NR NR	NR NR	NR NR	39 8	40 8	39 6	10	-1 0	2	39 -2	190	2,530.1 2.842.7	294,600 312.600	341 325	2726 2728	2761	3276.2 9.7	15.2 9.7	0.8 5.2	1.6 3.4	1.2 5.8	2.5 5.6
	Mon	12/28/09	7:15 AM	11,335.0	17,044.5	12.6	12.6	NR	NR	NR	8	10	9	10	-2	-1	-2	0	3,175.6	332,900	440	2731	2768	24.5	14.8	1.4	1.2	1.7	1.4
	Tue	12/29/09 12/30/09	8:00 AM 7:00 AM	11,352.2 11,367.3	17,061.7 17,076.4	17.2 15.1	17.2 14.7	NR NR	NR NR	NR NR	8 26	9 23	8 22	10 15	-1 3	0 4	-2 11	0 435	225.5 554.0	225,500 328,500	219 368	2733 2735	2771 2774	34.8 45.0	10.3 10.2	2.1 3.1	1.3	3.2 4.5	1.6 2.6
178	Thu	12/31/09	7:00 AM	11,378.4	17,087.4	11.1	11.0	NR	NR	NR	27	22	22	15	5	5	12	427	839.8	285,800	431	2737	2777	56.0	11.0	4.5	2.3	7.1	5.4
	Fri Sat	01/01/10	NR NR	11,389.2 11.400.3	17,098.6 17,109.9	10.8 11.1	11.2 11.3	NR NR	NR NR	NR NR	26 25	25 25	22	18 16	0	2	8	430 454	1,120.4 1,400.7	280,600 280,300	425 417	2740	2780 2783	67.5 79.2	11.5 11.7	0.3	2.7 1.4	6.6 1.6	4.5 1.6
	Sun	01/03/10	NR	11,418.0	17,127.0	17.7	17.1	NR	NR	NR	25	24	21	14	1	4	11	430	1,735.0	334,300	320	2741	2786	88.3	9.1	3.2	1.5	4.9	2.9
	Mon Tue	01/04/10	9:00 AM 7:00 AM	11,436.3 11.451.3	17,144.9 17,159.4	18.3 15.0	17.9 14.5	NR NR	NR NR	NR NR	26 25	23	22 21	17	3	4	7	448	2,070.1 2,359.9	335,100 289,800	309 328	2746 2748		97.4 107.8	9.1 10.4	5.2 4.2	5.0 2.4	5.1 3.6	5.1 1.0
	Wed	01/06/10	7:00 AM	11,466.0	17,174.3	14.7	14.9	NR	NR	NR	16	15	14	15	1	2	1	256	2,686.3	326,400	368	2751	2794	120.0	12.2	2.3	2.3	1.6	1.6
179	Thu Fri	01/07/10	7:00 AM 6:50 AM	11,478.6 11,496.5	17,186.4 17,204.6	12.6 17.9	12.1 18.2	NR NR	NR NR	NR NR	26 16	22 16	24 14	18 18	4	2	-2	445 267	3,010.3 103.0	324,000 103,000	437 95	2753 2756	2798 2800	132.1 142.4	12.1 10.3	4.4 0.7	0.0	5.5 0.0	0.0
	Sat	01/09/10	8:00 AM	11,520.4	17,228.3	23.9	23.7	NR	NR	NR	17	16	16	15	1	1	2	509	152.2	49,200	34	2758	2803	288.6	146.2	5.2	0.0	0.0	0.0
	Sun	01/10/10	7:00 AM 7:00 AM	11,526.1 11,540.4	17,236.5 17,250.5	5.7 14.3	8.2 14.0	NR NR	NR NR	NR NR	8 26	3 23	4 24	0 19	5	2	7	NA 403	NA 804.4	NA 652,200	NA 768	NA 2760	NA 2806	NA 162.1	NA #VALUE!	0.0 4.6	0.0	8.2 1.5	0.0
	Tue	01/12/10	7:00 AM	11,559.9	17,279.7	19.5	29.2	NR	NR	NR	33	2	28	15	31	5	18	322	1,261.5	457,100	326	2763	2810	176.1	14.0	0.0	0.7	0.0	0.0
180	Wed	01/13/10	7:00 AM 6:30 AM	11,575.7 11,590.0	17,285.9 17,300.2	15.8 14.3	6.2 14.3	NR NR	NR NR	NR NR	26 26	22 24	22 21	16 15	2	5	10	408 424	1,647.7 1,986.7	386,200 339,000	723 395	2766 2768	2813	188.7 197.0	12.6 8.3	2.6	1.8	2.0 0.6	1.2 3.3
	Fri	01/15/10	7:00 AM	11,604.9	17,314.2	14.9	14.0	NR	NR	NR	26	20	23	16	6	3	10	399	2,327.8	341,100	394	2769	2818	205.0	8.0	8.1	0.1	3.7	0.0
	Sat	01/16/10	8:00 AM 8:00 AM	11,619.9 11,632.6	17,329.4 17,341.9	15.0 12.7	15.2 12.5	NR NR	NR NR	NR NR	8 35	9 27	7 2	10 15	-1 8	33	-2 20	304	2,700.2 3,014.5	372,400 314,300	411 416	2772	2821 2824	217.5 228.1	12.5 10.6	3.9 5.1	2.5 3.7	3.4 4.6	1.7 0.5
	Mon	01/18/10	NR	11,643.5	17,352.5	10.9	10.6	NR	NR	NR	8	9	8	10	-1	0	-2	0	6.9	6,900	11	2776	2827	238.3	10.2	4.4	2.9	4.7	3.1
	Tue	01/19/10	NR NR	11,655.6 11,681.2	17,364.3 17,377.4	12.1 NA	11.8 13.1	NR NR	NR NR	NR NR	25 41	23 41	23 41	18 NR	0	0	7 NA	414 206	321.8 666.0	314,900 344,200	439 #VALUE!	2779 2783	2832 2837	255.4 286.3	17.1 30.9	2.6 3.0	0.8	4.3 3.1	1.0 0.0
181	Thu	01/21/10	NR	11,689.5	17,388.8	NA	11.4	NR	NR	NR	8	10	8	10	-2	0	-2	0	939.4	273,400	#VALUE!	2784	2839	299.1	12.8	7.1	2.3	6.0	3.4
	Fri Sat	01/22/10	NR 8:00 AM	11,694.8 11,705.7	17,402.7 17.413.6	5.3 10.9	13.9 10.9	NR NR	NR NR	NR NR	8 26	10 24	9 22	10 16	-2 2	-1 4	-2 10	410	1,284.0 1,576.2	344,600 292,200	748 447	2786 2788		316.4 339.8	17.3 23.4	4.3 1.4	3.4 4.0	5.5 1.2	5.8 3.3
	Sun	01/24/10	10:00 AM	11,720.6	17,427.0	14.9	13.4	NR	NR	NR	25	25	23	16	0	2	9	430	1,908.4	332,200	392	2790	2848	363.2	23.4	0.2	1.5	0.0	0.5
	Mon Tue	01/25/10	7:00 AM 7:00 AM	11,733.2 11,745.8	17,438.4 17,449.9	12.6 12.6	11.4 11.5	NR NR	NR NR	NR NR	26 25	23 24	23 23	18 18	1	2	7	410 409	2,202.4 2,510.8	294,000 308,400	409 427	2792 2796	2854 2861	397.1 444.1	33.9 47.0	3.5 0.0	1.5	4.8 0.0	1.8 0.9
400	Wed	01/27/10	7:00 AM 8:30 AM	11,758.8	17,461.7	13.0	11.8	NR NR	NR NR	NR NR	25	24	23	19	1 2	2	6	405	2,832.5	321,700	433	2801	2869	500.0	55.9	0.1	1.5	0.0	1.9
182	Fri	01/28/10	6:55 AM	11,772.6 11,785.3	17,474.0 17,484.7	13.8 12.7	12.3 10.7	NR NR	NR NR	NR NR	25 33	23 30	23	18 15	3	30	18	422 311	3,162.2 178.2	329,700 178,200	422 256	2808	2876 2883	542.9 589.8	42.9 46.9	3.1 0.3	2.6 0.0	0.0	0.0
	Sat	01/30/10	7:33 AM	11,799.0 11,819.0	17,497.3	13.7	12.6	NR	NR	NR	33	44	28	15	-11	5	18 17	315	509.1	330,900	420	2811	2891	637.5	47.7	0.0	0.0	11.0	0.9
	Sun	01/31/10	8:00 AM 7:00 AM	11,819.0	17,515.8 17.530.0	20.0 15.9	18.5 14.2	NR NR	NR NR	NR NR	32 25	23	27 23	15 18	28 2	2	7	232 413	863.9 1.248.1	354,800 384,200	308 427		2900 2909	696.8 757.5	59.3 60.7	0.0 2.3	0.1 1.1	0.0 1.7	0.0
	Tue	02/02/10	7:00 AM	11,848.5	17,542.6	13.6	12.6	NR	NR	NR	25	23	22	18	2	3	7	419	1,588.4	340,300	434	2825	2917	808.5	51.0	1.8	1.2	1.0	0.7
183	Wed Thu	02/03/10	7:00 AM 7:30 AM	11,862.6 11.877.1	17,555.3 17,568.6	14.1 14.5	12.7 13.3	NR NR	NR NR	NR NR	26 25	23 23	23 23	18 18	2	3	7	429 423	1,936.8 2,293.0	348,400 356,200	435 428	2829	2925 2934	859.6 914.6	51.1 55.0	2.9	1.2 0.1	3.1 1.4	0.6
	Fri	02/05/10	7:00 AM	11,889.7	17,581.3	12.6	12.7	NR	NR	NR	25	24	22	18	1	3	7	210	2,598.3	305,300	402	2836	2837	940.4	25.8	0.3	2.0	0.0	1.9
	Sat	02/06/10	8:30 AM 8:30 AM	11,903.6 11.917.4	17,594.9 17,608.9	13.9 13.8	13.6 14.0	NR NR	NR NR	NR NR	25 25	23	22 23	18 18	2	3	7	413 419	2,931.1 3.272.1	332,800 341,000	403 409	2838	2941 2946	966.3 1000.0	25.9 33.7	2.9	0.3	3.1 2.4	0.5
	Mon	02/08/10	7:00 AM	11,933.7	17,624.3	16.3	15.4	NR	NR	NR	33	30	42	17	3	-9	16	396	330.0	330,000	347		2951	1040.6	40.6	0.7	0.0	0.5	0.0
	Tue	02/09/10	7:00 AM 7:00 AM	11,946.9 11,960.9	17,637.0 17,649.9	13.2 14.0	12.7 12.9	NR NR	NR NR	NR NR	24 25	22 22	22 22	16 17	3	3	8	432 422	652.6 973.4	322,600 320,800	415 398	2847 2849	2956 2959	1068.5 1089.9	27.9 21.4	2.0 4.0	0.4 2.8	2.6 4.7	0.5 3.7
184	Thu	02/11/10	6:55 AM	11,973.2	17,662.9	12.3	13.0	NR	NR	NR	8	10	10	11	-2	-2	-3	0	1,304.7	331,300	437	2852	2963	1119.3	29.4	0.5	2.4	0.0	1.9
	Fri Sat	02/12/10 02/13/10	7:00 AM 8:00 AM	11,986.1 11,999.7	17,675.0 17,687.9	12.9 13.6	12.1 12.9	NR NR	NR NR	NR NR	42 8	43 10	42 10	15 15	-1 -2	-2	-7	420 0	1,607.5 1,932.3	302,800 324,800	404 409	2854 2856	2966 2970	1141.0 1166.6	21.7 25.6	1.7 4.6	4.6 2.3	0.8 5.0	4.8 2.0
	Sun	02/14/10	8:00 AM	12,013.2	17,701.1	13.5	13.2	NR	NR	NR	25	24	22	17	1	3	8	411	2,264.0	331,700	414	2859	2974	1196.0	29.4	0.3	1.3	0.0	0.7
	Mon Tue	02/15/10	10:48 AM 8:40 AM	12,027.8 12.046.8	17,714.3 17,728.8	14.6 19.0	13.2 14.5	NR NR	NR NR	NR NR	8 25	10 23	10 21	11 16	-2 2	-2 4	-3 9	417	2,584.1 2.936.6	320,100 352,500	385 357	2861 2864	2978 2981	1221.5 1246.8	25.5 25.3	2.5 0.6	0.3 3.8	3.0 0.5	0.1 4.1
	Wed	02/17/10	7:30 AM	12,055.3	17,741.7	8.5	12.9	NR	NR	NR	24	22	22	15	2	2	9	419	3,248.7	312,100	508	2866	2985	1272.3	25.5	2.6	1.1	2.4	1.3
185	Thu	02/18/10	7:45 AM 6:35 AM	12,068.7 12.082.6	17,755.3 17.768.8	13.4 13.9	13.6 13.5	NR NR	NR NR	NR NR	25 8	22	22 10	15 10	-3	-2	10 -2	409 0	295.5 625.2	295,500 329,700	365 401	2868 2871	2989 2993	1297.7 1327.7	25.4 30.0	4.4 0.9	0.8 1.7	5.0 0.0	0.9
	Sat	02/20/10	9:00 AM	12,099.5	17,785.3	16.9	16.5	NR	NR	NR	34	27	3	15	7	31	19	282	959.3	334,100	333	2875	2998	1353.2	25.5	5.2	0.0	3.4	0.0
	Sun	02/21/10	8:30 AM	12,110.3	17,799.6	10.8	14.3	NR	NR	NR	27	23	21	16	4	6	11	384	1,258.3	299,000	405	2876	3000	1363.3	10.1	5.4	6.6	3.6	3.6

## APPENDIX B ANALYTICAL DATA TABLES

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Table B-1. Analytical Results from Long-Term Sampling at Arnaudville, LA

Sampling Date			08/10/06			08/15	5/06			08/2	22/06			08/29/	06			09/06/06	
Sampling Location		IN	AC	тт	IN	AC	TA	ТВ	IN	AC	TA	ТВ	IN	AC	TA	ТВ	IN	AC	тт
Parameter	Unit		7.0			λ.ο		.5		7.0				, to	174			7.0	
Alkalinity (as CaCO <sub>3</sub> )	mg/L	312	324	316	316 -	337	312	324	338	353	336	344	335	350	331	326	342	354 -	344
Ammonia (as N)	mg/L	1.9	1.7	1.3	-	-	-	-	-	-	-	-	-	-	-	-	2.2	2.0	1.1
Fluoride	mg/L	0.3	<0.1	<0.1	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1
Sulfate	mg/L	<1	<1	<1	-	-	-	-	-	-	-	-	-	-	-	-	<1	<1	<1
Nitrate (as N)	mg/L	<0.05	<0.05	0.1	-	-	-	-	-	-	-	-	-	-	-	-	<0.05	<0.05	0.2
Total P (as P)	μg/L	683	740 -	196 -	663	658 -	186	185 -	652 -	766 -	224	207	592 -	815 -	199 -	189	650 -	721 -	200
Silica (as SiO <sub>2</sub> )	mg/L	39.7	40.7	39.8	41.5	41.7	41.2	40.6	40.7	41.7	41.3	40.8	39.8	40.3	40.1	38.0	39.3	40.9	40.0
Turbidity	NTU	17.0	3.7	0.1	21.0	2.4	0.2	0.3	24.0	3.1	0.6	0.3	24.0	3.1	0.4	0.4	18.0	2.9	0.1
тос	mg/L	_	_	_		_		_		_	-	_		_				_	
pH	S.U.	6.8	7.3	7.3	7.0	7.2	7.2	7.2	6.8	7.3	7.3	7.3	6.9	7.4	7.3	7.3	6.9	7.3	7.3
Temperature	°C	25.0	25.0	25.0	21.9	24.9	24.4	24.9	24.0	23.7	23.7	23.6	24.9	24.9	24.9	25.0	23.6	23.5	23.7
DO	mg/L	1.5	7.2	3.2	0.9	5.5	2.1	1.6	2.2	6.5	3.8	4.3	1.7	7.0	3.3	3.9	2.3	5.6	3.4
ORP	mV	-2.7	244	258	-6.7	457	436	424	6.1	255	242	303	5.4	306	317	314	46.2	227	247
Total Chlorine	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Hardness (as CaCO <sub>3</sub> )	mg/L	264	252	251	-	-	-	-	-	-	-	-	-	-	-	-	264	263	258
Ca Hardness (as CaCO <sub>3</sub> )	mg/L	170	163	162	-	-	-	-	-	-	-	-	-	-	-	-	170	172	167
Mg Hardness (as CaCO <sub>3</sub> )	mg/L	93.6	88.7	89.0	-	-	-	-	-	-	-	-	-	-	-	-	94.1	90.8	90.9
As (total)	μg/L	38.2	38.8	11.8	28.8	28.8	8.7	9.5	36.3	38.3	11.1	10.7	30.8	36.3	10.7	10.4	28.5	30.2	10.5
As (soluble)	μg/L	32.4	10.7	10.5	-	-	-	-	-	-	-	-	-	-	-	-	28.5	10.2	10.7
As (particulate)	μg/L	5.9	28.1	1.3	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	20.0	<0.1
As (III)	μg/L	28.7	0.4	0.4	-	-	-	-	-	-	-	-	-	-	-	-	27.3	0.5	0.5
As (V)	μg/L	3.6	10.3	10.1	-	-	-	-	-	-	-	-	-	-	-	-	1.2	9.7	10.2
Fe (total)	μg/L	2,138 -	2,058	<25 -	2,304	1,890 -	<25 -	<25 -	1,851 -	1,938 -	<25 -	<25 -	2,059 -	2,602	<25 -	<25 -	2,088 -	1,950 -	<25 -
Fe (soluble)	μg/L	1,998	<25	<25	-	-	-	-	-	-	-	-	-	-	-	-	1,535	<25	<25
Mn (total)	μg/L	138	787 -	147 -	132 -	678 -	21 -	617 <sup>(a)</sup>	131 -	600	73 -	1443 <sup>(a)</sup>	148 -	932 -	358 -	202	142	750 -	384
Mn (soluble)	μg/L	141	229	147	-	-	-	-	-	-	-	-	-	-	-	-	148	424	394

<sup>(</sup>a) Samples re-run with similar results

Table B-1. Analytical Results from Long-Term Sampling at Arnaudville, LA (Continued)

Sampling Date			09/12/0	06			09/19/	06			09/26/	06			10/03/06	
Sampling Location																
Parameter	Unit	IN	AC	TA	ТВ	IN	AC	TA	ТВ	IN	AC	TA	ТВ	IN	AC	TT
		342	356	354	342	333	342	328	338	334	357	348	330	333	348	319
Alkalinity (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia (as N)	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	2.1	1.9	0.6
Fluoride	mg/L	-	-	-	-	1	-	-	-	-	-	-	-	0.2	0.2	0.2
Sulfate	mg/L	-	-	1	ı	ı	1	-	-	-	-	-	-	<1	<1	<1
Nitrate (as N)	mg/L	-	-	-	-	1	1	-	-	-	-	-	-	<0.05	<0.05	0.4
Total P (as P)	ug/l	611	692	171	186	570	666	199	201	493	585	206	196	596	700	265
Total F (as F)	μg/L	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
Silica (as SiO₂)	mg/L	40.3	41.0	40.8	41.5	41.8	43.2	43.4	43.0	39.9	41.5	40.9	41.8	40.6	41.8	41.7
Ollica (as 0102)	IIIg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	24.0	2.8	0.2	0.2	26.0	3.7	0.1	0.2	20.0	3.7	0.1	0.1	25.0	2.5	0.3
Turblatty	NIO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
рН	S.U.	6.9	7.4	7.3	7.3	6.9	7.3	7.3	7.3	6.9	7.3	7.3	7.3	6.0	7.3	7.3
Temperature	°C	23.4	23.4	23.4	23.5	22.5	22.3	22.2	22.3	20.8	20.6	20.8	20.7	22.3	22.8	23.1
DO	mg/L	2.5	5.7	3.2	2.9	3.0	5.5	3.1	2.9	3.0	5.3	2.6	2.3	2.2	4.8	3.1
ORP	mV	3.1	254	266	269	5.7	174	207	229	26.2	198	210	213	318 <sup>(c)</sup>	319	404
Total Chlorine	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	276	263	263
Ca Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	194	182	173
Mg Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	82.1	81.2	89.7
As (total)	μg/L	32.4	31.9	9.8	12.3	26.4	28.7	11.1	11.3	24.1	25.3	11.3	11.7	34.1	35.0	15.7
As (total)	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
As (soluble)	μg/L	-	-	-	-	-	-	-	-	-	-	-	-	28.4	17.4	13.8
As (particulate)	μg/L	-	-	-	-	-	-	-	-	-	-	-	-	5.7	17.6	1.9
As (III)	μg/L	-	-	-	-	-	-	-	-	-	-	-	-	23.4	10.5 <sup>(b)</sup>	0.6
As (V)	μg/L	-	-	-	-	-	-	-	-	-	-	-	-	5.0	6.9	13.2
Fe (total)	μg/L	2,040	2,031	<25	<25	2,104	2,001	<25	<25	2,082	2,115	<25	<25	1,999	1,972	<25
i e (total)	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fe (soluble)	μg/L	-	-	-	-	-	-	-	-	-	-	-	-	826	<25	<25
Mn (total)	μg/L	142	700	355	403	139	346	382	491	142	440	470	463	145	361 <sup>(b)</sup>	333
iviii (totai)	µg/∟	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mn (soluble)	μg/L	-	-	1	ı	ı	1	-	-	-	-	-	-	145	331	351

<sup>(</sup>a) Operator did not take water quality measurements. (b) Data indicated incomplete oxidation due to lower KMnO<sub>4</sub> dosage. (c) High influent ORP values.

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Table B-1. Analytical Results from Long-Term Sampling at Arnaudville, LA (Continued)

Sampling Date			10/10	/06			10/17/0	06			10/24/	06			10/31/	06			11/07/06	
Sampling Location																				
Parameter	Unit	IN	AC	TA	ТВ	IN	AC	TA	ТВ	IN	AC	TA	ТВ	IN	AC	TA	ТВ	IN	AC	TT
Allli-it- ( 0-00 )	/1	328	343	332	317	337	343	335	333	337	345	337	333	348	359	348	346	328	336	328
Alkalinity (as CaCO₃)	mg/L	-	-	-	-	-	-	-	-	337	356	333	335	-	-	-	-	-	-	-
Ammonia (as N)	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.8	1.7	0.5
Fluoride	mg/L	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	0.2	0.2	0.2
Sulfate	mg/L	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	<1	<1	<1
Nitrate (as N)	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.05	<0.05	0.5
Total P (as P)	μg/L	642	742 -	278 -	298	606 -	699 -	199	201	646 627	695 713	195 195	196 197	636	773 -	221	230	595 -	734 -	210
/		42.3	42.4	42.0	42.2	40.0	41.2	42.9	41.8	41.0	42.3	41.3	41.8	40.7	41.9	41.9	41.0	39.8	41.1	40.1
Silica (as SiO <sub>2</sub> )	mg/L	-	-	-	-	-	-	-	-	40.3	41.7	40.9	39.4	-	-	-	-	-	-	-
		23.0	2.9	0.7	0.7	19.0	3.4	0.5	0.5	24.0	3.3	0.5	0.7	23.0	2.9	0.5	0.6	23.0	3.0	0.5
Turbidity	NTU	-	-	-	-	-	-	-	-	22.0	3.4	0.4	0.3	-	-	-	-	-	-	-
TOC	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pН	S.U.	6.9	7.4	7.3	7.3	6.8	7.3	7.3	7.3	6.9	7.3	7.3	7.3	6.9	7.3	7.3	7.3	6.9	7.4	7.3
Temperature	°C	22.3	22.1	22.3	22.2	22.6	22.4	22.5	22.6	19.2	19.1	19.1	19.0	21.7	21.4	21.6	21.6	21.7	21.6	21.6
DO	mg/L	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	2.5	6.0	2.7	2.4	3.4	6.5	3.5	3.0	2.1	5.6	2.2	2.2	3.4	5.8	3.6
ORP	mV	NA <sup>(a)</sup>	140	NA <sup>(a)</sup>	NA <sup>(a)</sup>	32.8	209	232	232	371 <sup>(b)</sup>	355	363	363	424 <sup>(b)</sup>	407	412	408	373 <sup>(b)</sup>	388	385
Total Chlorine	mg/L	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-
Total Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	308	293	281
Ca Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	196	187	178
Mg Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112.0	106.0	103.0
As (total)	μg/L	32.6	30.9	14.4	17.7	33.1	35.7	12.3	12.2	39.1	38.9	12.6	12.9	32.9	34.1	11.0	11.1	26.8	30.7	9.0
710 (total)	P9/L	-	-	-	-	-	-	-	-	36.9	38.5	12.8	13.1	-	-	-	-	-	-	-
As (soluble)	μg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27.7	10.2	8.6
As (particulate)	μg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	20.5	0.4
As (III)	μg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24.1	1.3	1.3
As (V)	μg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.6	8.9	7.3
Fe (total)	μg/L	1,878 -	1,669 -	<25 -	<25 -	2,012 -	2,026	<25 -	<25 -	2,457 2,509	2,331 2,294	<25 <25	<25 <25	2,261 -	2,224	<25 -	<25 -	2,372	2,375	<25 -
Fe (soluble)	μg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,277	<25	<25
Mn (total)	μg/L	141	345 <sup>(b)</sup>	260	341	153	633	299	382	138	622	383	443	154	793	347	310	173	784	306
Mn (soluble)	μg/L	-	-	-	-	-	-	-	-	138	619	384	441	-	-	-	-	180	322	307

<sup>(</sup>a) IN and AC sample bottles were switched for this event. Corrected results are displayed. (b) High influent ORP values.

Table B-1. Analytical Results from Long-Term Sampling at Arnaudville, LA (Continued)

Sampling Date			11/14	1/06			11/28	/06			12/05/06			12/1	9/06			01/0	1/07	
Sampling Location		(-)	(-)																	
Parameter	Unit	IN <sup>(a)</sup>	AC <sup>(a)</sup>	TA	ТВ	IN	AC	TA	ТВ	IN	AC	TT	IN	AC	TA	ТВ	IN	AC	TA	ТВ
Alkalinity (as CaCO <sub>3</sub> )	ma/l	330	336	324	332	350	363	350	352	337	361	333	347	355	351	355	361	365	359	371
Alkalifility (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia (as N)	mg/L	-	-	-	-	-	1	-	-	1.9	1.8	8.0	-	1	-	-	-	-	-	-
Fluoride	mg/L	-	-	-	-	-	-	-	-	0.2	0.2	0.2	-	-	-	-	-	-	-	-
Sulfate	mg/L	-	-	-	-	-	1	-	-	<1	<1	<1	-	1	-	-	1	-	-	-
Nitrate (as N)	mg/L	-	-	-	-	-	-	-	-	<0.05	<0.05	0.6	-	1	-	-	-	-	-	-
Total P (as P)	μg/L	651 -	748	216	217	474	632	154 -	155 -	552 -	717	177 -	581 -	741 -	220	252 -	569 -	723 -	213	221
Silica (as SiO <sub>2</sub> )	mg/L	39.7	40.3	39.6	40.8	42.2	43.2	43.2	42.7	39.6	40.5	40.3	41.7	42.5	42.8	42.9	41.7	42.8	41.1	43.2
Turbidity	NTU	24.0	3.1	0.3	0.4	22.0	2.5	0.4	0.7	20.0	4.6	0.5	25.0	4.2	0.9	0.9	20.0	3.2	0.7	0.6
TOO	//	-		-		-				-	- 4.0	-	-	-		-	-		-	-
TOC	mg/L	-	-		- 7.4	-	-		-	1.6	1.3	1.2	-	-	- NA (3)	-	-	- NA <sup>(a)</sup>	-	-
pH T	S.U.	6.8	7.3	7.4	7.4	6.8	7.3	7.3	7.3	6.9	7.4	7.4	7.0	7.0	NA <sup>(a)</sup>	7.5	NA <sup>(a)</sup>		NA <sup>(a)</sup>	NA <sup>(a)</sup>
Temperature	°C	20.1	20.1	20.1	20.0	21.9	21.6	21.6	21.7	16.6	16.6	16.8	20.8	20.6	20.7	20.7	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>
DO	mg/L	2.6	5.5	2.9	2.5	2.4	4.9	2.2	2.7	4.7	4.7	4.8	-	-	-	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>
ORP	mV	389 <sup>(b)</sup>	359	265	372	403	313	313	318	428	389	391	-	-	-	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>
Total Chlorine	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	303	282	273	-	-	-	-	-	-	-	-
Ca Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	206	188	180	-	-	-	-	-	-	-	-
Mg Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	96.7	93.8	93.0	-	-	-	-	-	-	-	-
As (total)	μg/L	36.5	36.6	12.1	12.9	27.3	31.7 -	10.3	10.5	35.3 -	37.6	12.0	29.9	33.8	13.1	13.6	36.8	37.6 -	14.4	14.7
As (soluble)	μg/L	-	-	-	-	-	-	-	-	30.4	14.2	11.5	-	-	-	-	-	-	-	-
As (particulate)	μg/L	-	-	-	-	-	-	-	-	4.9	23.4	0.5	-	-	-	-	-	-	-	-
As (III)	μg/L	-	-	-	-	-	-	-	-	26.6	1.7	0.9	-	-	-	-	-	-	-	-
As (V)	μg/L	-	-	-	-	-	-	-	-	3.8	12.5	10.6	-	-	-	-	-	-	-	-
Fe (total)	μg/L	1,981	1,920	<25 -	<25 -	1,914	1,939	<25 -	<25 -	2,042	2,065	<25 -	2,207	2,222	93 <sup>(b)</sup>	149 <sup>(b)</sup>	2,230	2,226	31 <sup>(b)</sup>	28 <sup>(b)</sup>
Fe (soluble)	μg/L	-	-	-	-	-	-	-	-	1,965	<25	<25	-	-	-	-	-	-	-	-
Mn (total)	μg/L	141	755 -	225	187 -	135	545 -	232	238	150	720 -	288	155 -	627	605 <sup>(b)</sup>	564 <sup>(b)</sup>	145	536 -	482 <sup>(b)</sup>	394 <sup>(b)</sup>
Mn (soluble)	μg/L	-	-	-	-	-	-	-	-	158	474	304	-	-	-	-	-	-	-	-
(a) Operator did not take water								<u> </u>	<u> </u>						l	l		l	l	<u> </u>

<sup>(</sup>a) Operator did not take water quality measurements.
(b) Effluent Mn and Fe levels elevated after acid/base wash and return to service on 12/12/07. Some particulate Fe/Mn leakage may have occurred.

Table B-1. Analytical Results from Long-Term Sampling at Arnaudville, LA (Continued)

Sampling Date			01/09/07			01/16/	07			01/2	4/07			01/30/07			02/06/0	)7 <sup>(b)</sup>	
Sampling Location Parameter	Unit	IN	AC	тт	IN	AC	TA	ТВ	IN	AC	TA	ТВ	IN	AC	TT	IN	AC	TA	тв
Alkalinity (as CaCO <sub>3</sub> )	mg/L	332	351 -	354 -	347	351 -	349	355 -	334 322	339 334	330 326	339 335	351 -	368 -	347	338	357 -	341	346
Ammonia (as N)	mg/L	1.5	1.7	1.7	-	-	-	-	-	-	-	-	1.9	1.8	1.3	-	-	-	-
Fluoride	mg/L	0.2	0.3	0.2	-	-	-	-	-	-	-	-	0.2	0.2	0.2	-	-	-	-
Sulfate	mg/L	<1	<1	<1	-	-	-	-	-	-	-	-	<1	<1	<1	-	-	-	-
Nitrate (as N)	mg/L	<0.05	<0.05	<0.05	-	-	-	-	-	-	-	-	<0.05	0.1	0.1	-	-	-	-
Total P (as P)	μg/L	542 -	717 -	240	526 -	700 -	161 -	112	574 566	657 668	175 183	179 176	703 -	643 -	211 -	547 -	662	216 -	219 -
Silica (as SiO <sub>2</sub> )	mg/L	41.3	42.0	42.6	41.4	42.9	41.4	41.7	39.9 39.4	41.2 40.5	40.6 40.8	40.1 40.7	38.4	40.8	40.4	39.5 -	40.5	40.2	38.7
Turbidity	NTU	23.0	3.1	0.8	22.0	3.3	0.5	0.5	22.0 22.0	3.3 3.3	0.5 0.5	0.6 0.6	34.0	4.5 -	0.9	23.0	3.9	0.4	0.5
TOC	mg/L	1.3	1.3	1.2	-	-	-	-	-	-	-	-	1.2	1.4	1.2	1.5	1.6	1.4	1.4
pН	S.U.	NA <sup>(a)</sup>	6.9	7.3	7.5	7.5	6.8	7.4	7.5	7.0	7.0	7.5	7.5						
Temperature	°C	NA <sup>(a)</sup>	18.1	18.3	18.2	18.0	18.1	18.1	18.1	17.4	17.7	17.3	17.5						
DO	mg/L	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	3.7	5.6	4.9	4.8	3.2	5.9	4.5	3.8	4.0	6.2	5.1	3.5	4.1	6.2	4.7
ORP	mV	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	409	392	391	391	420	384	381	386	412	387	371	381	376	389	393
Total Chlorine	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Hardness (as CaCO <sub>3</sub> )	mg/L	288	247	241	-	-	-	-	-	-	-	-	304	286	273	-	-	-	-
Ca Hardness (as CaCO <sub>3</sub> )	mg/L	181	151	146	-	-	-	-	-	-	-	-	200	188	182	-	-	-	-
Mg Hardness (as CaCO <sub>3</sub> )	mg/L	106.6	95.7	95.0	-	-	-	-	-	-	-	-	104.0	97.8	91.4	-	-	-	-
As (total)	μg/L	30.3	32.0	13.2	25.4	28.4	10.7	10.6	34.4 34.8	35.9 36.6	12.5 13.5	13.6 13.5	32.8	31.8	12.8	27.1	27.6	13.3	13.9
As (soluble)	μg/L	30.1	19.0	12.5	-	-	-	-	-	-	-	-	35.8	14.6	12.6	-	-	-	-
As (particulate)	μg/L	0.2	13.0	0.7	-	-	-	-	-	-	-	-	<0.1	17.2	0.2	-	-	-	-
As (III)	μg/L	10.2	2.8	0.7	-	-	-	-	-	-	-	-	26.5	4.4	3.2	-	-	-	-
As (V)	μg/L	19.9	16.2	11.8	-	-	-	-	-	-	-	-	9.3	10.2	9.4	-	-	-	-
Fe (total)	μg/L	2,013	2,003	95 -	2,002	1,974 -	<25 -	<25 -	2,055 2,005	1,822 1,826	<25 <25	<25 <25	1,285	904	<25 -	1,640 -	1,558 -	<25 -	<25 -
Fe (soluble)	μg/L	1,788	<25	<25	-	-	-	-	-	-	-	-	902	<25	<25	-	-	-	-
Mn (total)	μg/L	147 -	536 -	129 -	133	475 -	57.7 -	128	129 130	468 482	155 156	208 209	105 -	450 -	126 -	105 -	180	135 -	150 -
Mn (soluble)	μg/L	152	478	156	-	-	-	-	-	-	-	-	28.9	21.4	20.2	-	-	-	-

<sup>(</sup>a) Operator did not take water quality measurements. (b) TOC samples analyzed out of hold time. (c) Operator reported that chlorine injection started on February 19, 2007

Table B-1. Analytical Results from Long-Term Sampling at Arnaudville, LA (Continued)

Sampling Date			02/21/0	)7 <sup>(c)</sup>			02/	27/07			03/06/07			03/13/	07 <sup>(d)</sup>			03/21/0	7 <sup>(b)</sup>	
Sampling Location	1	IN	AC	TA	ТВ	IN	AC	TA	тв	IN	AC	тт	IN	AC	TA	ТВ	IN	AC	TA	ТВ
Parameter	Unit	IIV	AC	14	16	IIV	AC	IA.	16	IIN	AC	11	IIN	AC	IA.	16	IIV	AC	14	16
Alkalinity (as CaCO <sub>3</sub> )	mg/L	368	339	344	339	345	345	338	321	346	339	346	358	351	346	343	337	332	328	328
Aikalifility (as CaCO <sub>3</sub> )	IIIg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia (as N)	mg/L	-	-	-	-	-	-	-	-	1.9	1.7	1.4	1	-	-	-	-	-	-	-
Fluoride	mg/L	-	-	-	-	-	-	-	-	0.2	0.2	0.2	-	-	-	-	-	-	-	-
Sulfate	mg/L	-	-	-	-	-	-	-	-	<1	<1	<1	1	-	-	-	-	-	-	-
Nitrate (as N)	mg/L	-	-	-	-	-	-	-	-	<0.05	<0.05	<0.05	1	-	-	-	-	-	-	-
Total P (as P)	ug/l	762	755	237	225	752	747	243	241	808	795	241	681	671	195	195	766	770	202	192
Total P (as P)	μg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silica (as SiO <sub>2</sub> )	mg/L	41.9	42.8	42.1	42.9	42.3	42.7	41.7	41.0	41.5	41.7	41.2	41.4	41.7	41.3	41.2	43.5	43.7	42.9	43.4
		22.0	7.4	0.9	0.1	9.2 <sup>(c)</sup>	5.7	0.6	0.4	12.0 <sup>(c)</sup>	8.1	1.0	29.0	12.0	7.2	4.4	29.0	7.2	2.7	1.3
Turbidity	NTU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC	mg/L	-	-	-	-	-	-	-	-	1.8	1.7	1.7	_	-	-	-	-	-	-	-
pH	S.U.	6.8	7.2	7.3	7.3	6.9	7.3	7.4	7.4	7.0	7.3	7.4	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	6.9	7.2	7.3	7.3
Temperature	°C	20.7	20.6	20.6	20.6	14.6	NA <sup>(a)</sup>	19.8	19.8	18.6	18.7	18.6	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	21.0	20.9	21.0	21.0
DO	mg/L	3.3	3.1	5.5	6.1	2.9	5.8	4.8	5.6	3.8	5.6	5.6	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	2.3	4.8	5.7	6.0
ORP	mV	406	386	412	412	416	479	445	440	407	416	415	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	420	448	448	443
Total Chlorine	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	NA <sup>(a)</sup>	-	NA <sup>(a)</sup>	-	1.6	-	1.3
Total Hardness (as CaCO₃)	mg/L	-	-	-	-	-	-	-	-	298	302	263	-	-	-	-	-	-	-	-
Ca Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	193	194	170	-	-	-	-	-	-	-	-
Mg Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	105.0	108.0	92.8	-	-	-	-	-	-	-	-
As (total)	μg/L	43.0	41.6	19.9	18.8	32.8	32.9	17.5	17.8	39.7	41.1	19.0	35.9	37.0	15.8	16.3	40.1	39.9	19.8	18.6
715 (total)	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
As (soluble)	μg/L	-	-	-	-	-	-	-	-	33.5	22.2	15.6	-	-	-	-	-	-	-	-
As (particulate)	μg/L	-	-	-	-	-	-	-	-	6.2	18.9	3.4	-	-	-	-	-	-	-	-
As (III)	μg/L	-	-	-	-	-	-	-	-	29.6	3.2	2.3	-	-	-	-	-	-	-	-
As (V)	μg/L	-	-	-	-	-	-	-	-	3.9	19.0	13.3	-	-	-	-	-	-	-	-
Fe (total)	μg/L	1,522	1,460	<25 -	<25 -	1,618 -	1,538	<25 -	<25 -	1,619 -	1,548 -	<25 -	1,476 -	1,385	<25 -	<25 -	1,733 -	1,726 -	<25 -	<25 -
Fe (soluble)	μg/L	-	-	_	-	-	-	-	-	1,460	<25	<25	-	-	-	-	-	-	-	_
, ,		103	90.2	101	101	196	142	228 <sup>(c)</sup>	211 <sup>(c)</sup>	123	120	138	96.2	96.9	195	198	98.9	101	110	103
Mn (total)	µg/L	_	-	_	-	_	_	_	_	_	_	-	-	-	_	-	_	_	_	_
Mn (soluble)	μg/L	-	-	_	-	-	_	-	-	124	117	139	_	_	_	_	_	-	_	_
(a) Operator did not		<u> </u>	<u> </u>	<u> </u>	L	<u> </u>	<u> </u>	<u> </u>	1					l		l			l	

<sup>(</sup>a) Operator did not take water quality measurements. (b) Operator began taking chlorination measurements. (c) Samples rerun with similar results. (d) Operator reported that aeration blower was turned off on March 8, 2007

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Table B-1. Analytical Results from Long-Term Sampling at Arnaudville, LA (Continued)

Parameter         Unit           Alkalinity (as CaCO₃)         mg/L           Ammonia (as N)         mg/L           Fluoride         mg/L           Sulfate         mg/L           Nitrate (as N)         mg/L           Total P (as P)         μg/L           Silica (as SiO₂)         mg/L           Turbidity         NTU           TOC         mg/L           pH         S.U.           Temperature         °C           DO         mg/L           Total Chlorine         mg/L           Total Hardness (as CaCO₃)         mg/L           Ca Hardness (as CaCO₃)         mg/L           Mg Hardness (as CaCO₃)         mg/L           As (total)         μg/L	IN 334 334 873 861 42.1 42.6 25.0 26.0 - 6.9 21.8	329 324 - - - 788 818 41.8 41.4 5.9 6.0 - 7.1	TA  326 324  181 188 42.1 41.2 0.1 0.4 - 7.2	TB  324 329  180 186 41.9 42.1 0.4 0.3	1N  335 751 - 40.2 - 21.0	AC 335	TA  322 189 - 40.8 - 0.5	TB  325 184 - 40.8	1.8 0.2 <1 <0.05 701 - 42.2	AC  334 - 1.6 0.2 <1 <0.05 684 - 41.8	336 - 1.4 0.2 <1 0.1 190 - 42.1	338 688 - 43.2	AC 330 663 43.4	TA 326 181	TB 330 192	IN 340 826	AC 340 799	TA 340 183	335 176
Parameter         Unit           Alkalinity (as CaCO₃)         mg/L           33         33           Ammonia (as N)         mg/L           Fluoride         mg/L           Sulfate         mg/L           Nitrate (as N)         mg/L           Total P (as P)         μg/L           8         8           8         8           8         8           8         8           8         8           8         8           8         8           8         8           8         8           8         8           8         8           8         8           8         8           8         8           8         8           8         8           8         8           9         4           9         4           10         1           10         1           10         1           10         1           10         1           10         1           10         1     <	334 334 - - - 873 861 42.1 42.6 25.0 26.0 - 6.9	329 324 - - - 788 818 41.8 41.4 5.9 6.0 - 7.1	326 324 - - - 181 188 42.1 41.2 0.1 0.4 -	324 329 - - - 180 186 41.9 42.1 0.4	335 - - - - - - 751 - 40.2	335 - - - - - - - - - - - - -	322 - - - - - 189 - 40.8	325 184 	341 - 1.8 0.2 <1 <0.05 701 -	334 - 1.6 0.2 <1 <0.05 684 -	336 - 1.4 0.2 <1 0.1 190 -	338 - - - - - - 688	330 - - - - - - - 663 -	326 - - - - - 181	330	340	340	340	335
Alkalinity (as CaCO <sub>3</sub> ) mg/L  Ammonia (as N) mg/L  Fluoride mg/L  Sulfate mg/L  Nitrate (as N) mg/L  Total P (as P) μg/L  Silica (as SiO <sub>2</sub> ) mg/L  Turbidity NTU  TOC mg/L  pH S.U.  Temperature °C 22  DO mg/L  ORP mV 33  Total Chlorine mg/L  Total Hardness (as CaCO <sub>3</sub> ) mg/L  Mg Hardness (as CaCO <sub>3</sub> ) mg/L  As (total) μg/L  4  3	334 - - 873 861 42.1 42.6 25.0 26.0 - 6.9	324 - - - - 788 818 41.8 41.4 5.9 6.0 - 7.1	324 - - - 181 188 42.1 41.2 0.1 0.4	329 - - - 180 186 41.9 42.1 0.4	- - - - - 751 - 40.2	- - - - - 729 - 41.3	- - - - - 189 - 40.8	- - - - 184	- 1.8 0.2 <1 <0.05 701 -	- 1.6 0.2 <1 <0.05 684 -	- 1.4 0.2 <1 0.1 190	- - - - - 688	- - - - - 663	- - - - 181	-	- - -			-
Ammonia (as N) mg/L  Fluoride mg/L  Sulfate mg/L  Nitrate (as N) mg/L  Total P (as P) μg/L  Silica (as SiO <sub>2</sub> ) mg/L  Turbidity NTU  TOC mg/L  pH S.U.  Temperature °C 2  DO mg/L  ORP mV 3  Total Chlorine mg/L  Total Hardness (as CaCO <sub>3</sub> ) mg/L  Mg Hardness (as CaCO <sub>3</sub> ) mg/L  As (total) μg/L  4  3	- 873 861 42.1 42.6 25.0 26.0	- 788 818 41.8 41.4 5.9 6.0	- - - 181 188 42.1 41.2 0.1 0.4	- - - 180 186 41.9 42.1 0.4	- - - 751 - 40.2	- - - 729 - 41.3	- - - 189 - 40.8	- - - 184	0.2 <1 <0.05 701	1.6 0.2 <1 <0.05 684	1.4 0.2 <1 0.1 190	- - - - 688	- - - 663 -	- - - 181	-		- - -	-	- - -
Fluoride         mg/L           Sulfate         mg/L           Nitrate (as N)         mg/L           Total P (as P)         μg/L           Silica (as SiO₂)         mg/L           4         4           Turbidity         NTU           2         2           pH         S.U.           Temperature         °C           DO         mg/L           ORP         mV           Total Chlorine         mg/L           Total Hardness (as CaCO₃)         mg/L           Mg Hardness (as CaCO₃)         mg/L           As (total)         μg/L           4         3	- 873 861 42.1 42.6 25.0 26.0	- 788 818 41.8 41.4 5.9 6.0	- - 181 188 42.1 41.2 0.1 0.4	- - 180 186 41.9 42.1 0.4	- - - 751 - 40.2	- - - 729 - 41.3 - 6.7	- - - 189 - 40.8	- - - 184	0.2 <1 <0.05 701	0.2 <1 <0.05 684	0.2 <1 0.1 190	- - - 688	- - - 663 -	- - - 181	-		-	-	- - -
Sulfate         mg/L           Nitrate (as N)         mg/L           Total P (as P)         μg/L           Silica (as SiO₂)         mg/L           4         μg/L	- 873 861 42.1 42.6 25.0 26.0 - 6.9	788 818 41.8 41.4 5.9 6.0	- 181 188 42.1 41.2 0.1 0.4	- 180 186 41.9 42.1 0.4	- - 751 - 40.2	- 729 - 41.3 - 6.7	- 189 - 40.8	- - 184 -	<1 <0.05 701	<1 <0.05 684 -	<1 0.1 190 -	- - 688 -	- 663 -	- - 181 -	-	-	-	-	-
Nitrate (as N)         mg/L           Total P (as P)         μg/L           Silica (as SiO₂)         mg/L           Turbidity         NTU           TOC         mg/L           pH         S.U.           Temperature         °C           DO         mg/L           ORP         mV           Total Chlorine         mg/L           Total Hardness (as CaCO₃)         mg/L           Mg Hardness (as CaCO₃)         mg/L           As (total)         μg/L           4         3	- 873 861 42.1 42.6 25.0 26.0 - 6.9	788 818 41.8 41.4 5.9 6.0	- 181 188 42.1 41.2 0.1 0.4	- 180 186 41.9 42.1 0.4	- 751 - 40.2	- 729 - 41.3 - 6.7	- 189 - 40.8	- 184 -	<0.05 701 -	<0.05 684 -	0.1 190 -	- 688 -	- 663 -	- 181 -	-	-	-	-	-
Total P (as P)  Silica (as SiO <sub>2</sub> )  mg/L  Turbidity  TOC  pH  S.U.  Temperature  DO  mg/L  ORP  Total Chlorine  Total Hardness (as CaCO <sub>3</sub> )  Mg/L  Ca Hardness (as CaCO <sub>3</sub> )  Mg/L  Mg Hardness (as CaCO <sub>3</sub> )  Mg/L  As (total)	873 861 42.1 42.6 25.0 26.0 - 6.9	788 818 41.8 41.4 5.9 6.0	181 188 42.1 41.2 0.1 0.4	180 186 41.9 42.1 0.4	751 - 40.2 -	729 - 41.3 - 6.7	189 - 40.8	184	701	684 -	190 -	688	663	181					
Total P (as P)       μg/L       8         Silica (as SiO₂)       mg/L       4         Turbidity       NTU       2         TOC       mg/L       9         pH       S.U.       6         Temperature       °C       2         DO       mg/L       3         ORP       mV       3         Total Chlorine       mg/L       3         Total Hardness (as CaCO₃)       mg/L       4         Mg Hardness (as CaCO₃)       mg/L       4         As (total)       μg/L       4         3       3       4	861 42.1 42.6 25.0 26.0 - 6.9	818 41.8 41.4 5.9 6.0	188 42.1 41.2 0.1 0.4	186 41.9 42.1 0.4	- 40.2 -	41.3 - 6.7	- 40.8 -	-	-	-	-	-	-	-	192 -	826	799	183	176
Silica (as SiO₂)       mg/L       4         Turbidity       NTU       2         TOC       mg/L       2         pH       S.U.       6         Temperature       °C       2         DO       mg/L       3         ORP       mV       3         Total Chlorine       mg/L       3         Total Hardness (as CaCO₃)       mg/L       4         Mg Hardness (as CaCO₃)       mg/L       4         As (total)       μg/L       4         3       3       4         4       3       3	42.1 42.6 25.0 26.0 - 6.9	41.8 41.4 5.9 6.0 - 7.1	42.1 41.2 0.1 0.4	41.9 42.1 0.4	_	6.7	-	- 40.8 -	42.2				- 40.4	-	-	_			1
Silica (as SiO₂)         mg/L         4           Turbidity         NTU         2           TOC         mg/L         2           pH         S.U.         6           Temperature         °C         2           DO         mg/L         3           ORP         mV         3           Total Chlorine         mg/L           Total Hardness (as CaCO₃)         mg/L           Mg Hardness (as CaCO₃)         mg/L           As (total)         μg/L	42.6 25.0 26.0 - 6.9	41.4 5.9 6.0 - 7.1	41.2 0.1 0.4	42.1 0.4	_	6.7	-	40.8	42.2	41.8	42.1				40.0	40.4	-	-	-
Turbidity NTU 2 2  TOC mg/L pH S.U. 6 Temperature °C 2  DO mg/L 3  ORP mV 3  Total Chlorine mg/L  Total Hardness (as CaCO <sub>3</sub> ) mg/L  Ca Hardness (as CaCO <sub>3</sub> ) mg/L  Mg Hardness (as CaCO <sub>3</sub> ) mg/L  As (total) μg/L 4 3	25.0 26.0 - 6.9	5.9 6.0 - 7.1	0.1 0.4	0.4	21.0	6.7	0.5	-	-				43.4	43.5	43.6	43.1	43.2	42.9	43.2
Turbidity         NTU         2           TOC         mg/L         pH           pH         S.U.         6           Temperature         °C         2           DO         mg/L         3           ORP         mV         3           Total Chlorine         mg/L         3           Total Hardness (as CaCO3)         mg/L         mg/L           Ca Hardness (as CaCO3)         mg/L         mg/L           Mg Hardness (as CaCO3)         mg/L         4           As (total)         μg/L         4           3         3         3	26.0	6.0 - 7.1	0.4		21.0		0.5			-	-	-		-	-	-	-	-	-
pH         S.U.         6           Temperature         °C         2           DO         mg/L         3           ORP         mV         3           Total Chlorine         mg/L         3           Total Hardness (as CaCO <sub>3</sub> )         mg/L         3           Ca Hardness (as CaCO <sub>3</sub> )         mg/L         4           Mg Hardness (as CaCO <sub>3</sub> )         μg/L         4           As (total)         μg/L         3	6.9			-		-	-	0.7	26.0	11.0 -	2.0	28.0	7.0 -	0.8	1.3	25.0	16.0 -	0.7	0.9
Temperature °C 2  DO mg/L 3  ORP mV 3  Total Chlorine mg/L  Total Hardness (as CaCO₃) mg/L  Ca Hardness (as CaCO₃) mg/L  Mg Hardness (as CaCO₃) mg/L  As (total) μg/L 4  3			7.2		-	-	-	-	1.5	1.4	1.3	-	-	-	-	-	-	-	-
DO         mg/L         3           ORP         mV         3           Total Chlorine         mg/L	21.8	04.0	-	7.3	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	6.9	7.1	7.2	7.2	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>
ORP mV 3  Total Chlorine mg/L  Total Hardness (as CaCO <sub>3</sub> ) mg/L  Ca Hardness (as CaCO <sub>3</sub> ) mg/L  Mg Hardness (as CaCO <sub>3</sub> ) mg/L  As (total) μg/L 4  3		21.6	21.7	21.8	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	19.8	20.0	19.9	20.0	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>
Total Chlorine         mg/L           Total Hardness (as CaCO₃)         mg/L           Ca Hardness (as CaCO₃)         mg/L           Mg Hardness (as CaCO₃)         mg/L           As (total)         μg/L         4           3         3	3.3	5.3	4.5	5.5	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	3.4	5.3	4.2	3.8	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>
Total Hardness (as CaCO <sub>3</sub> ) mg/L  Ca Hardness (as CaCO <sub>3</sub> ) mg/L  Mg Hardness (as CaCO <sub>3</sub> ) mg/L  As (total) μg/L  4 3	395	334	387	423	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	409	445	479	463	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>
Ca Hardness (as CaCO₃)         mg/L           Mg Hardness (as CaCO₃)         mg/L           As (total)         μg/L         4           3         3	-	1.7	-	0.5	-	NA <sup>(a)</sup>	-	NA <sup>(a)</sup>	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>	-	2.5	-	0.9	-	NA <sup>(a)</sup>	-	NA <sup>(a)</sup>
Mg Hardness (as CaCO <sub>3</sub> ) mg/L  As (total) μg/L 4 3	-	-	-	-	-	-	-	-	243	246	253	-	-	-	-	-	-	-	-
As (total) µg/L 3	-	-	-	-	-	-	-	-	165	166	169	-	-	-	-	-	-	-	-
As (total) µg/L 3	-	-	-	-	-	-	-	-	77.1	80.4	83.8	-	-	-	-	-	-	-	-
3	40.5	36.5	16.5	16.6	38.1	36.9	16.8	16.2	39.5	38.8	17.7	40.5	39.6	15.9	18.4	39.8	39.3	34.3	32.5
	38.2	37.8	16.4	16.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
As (soluble) µg/L	-	-	-	-	-	-	-	-	34.1	17.5	16.2	-	-	-	-	-	-	-	-
As (particulate) μg/L	-	-	-	-	-	-	-	-	5.4	21.3	1.5	-	-	-	-	-	-	-	-
As (III) μg/L	-	-	-	-	-	-	-	-	30.7	8.0	2.1	-	-	-	-	-	-	-	-
As (V) μg/L	-	-	-	-	-	-	-	-	3.4	16.7	14.1	-	-	-	-	-	-	-	-
Fe (total)	1,959 2,005	1,869 1,886	<25 <25	<25 <25	1,889	1,810	<25	<25	1,618	1,521	<25 -	2,595	2,417	<25	<25	2,453	2,205	<25	<25 -
Fe (soluble) µg/L	2,005	1,000	-	-20		-	-	-	1,693	- <25	<25	-	<u> </u>	-	_	_	-		-
· · · · · · · · · · · · · · · · · · ·		115	135	120	107	109	109		98	97	175	163						267	281
Mn (total) µg/L	113	116	135	130 129	-	109	-	112	-	97	-	-	164	169	168	151	152 -	-	281
Mn (soluble) μg/L	116	-	-	-	-	-	_	-	105	88.8	189	-	-	-	-	-	-	-	-

<sup>(</sup>a) Operator did not take water quality measurements. (b) Speciation study sampling began on 01/23/08 for 3 sampling events.

Table B-1. Analytical Results from Long-Term Sampling at Arnaudville, LA (Continued)

Sampling Date		0	1/23/08 <sup>(b)</sup>	)	0.	1/28/08 <sup>(b)</sup>		(	3/11/08 <sup>(b)</sup>			03/19/08			03/24/08			04/17/08	
Sampling Location		IN	AC	тт	IN	AC	TT	IN	AC	TT	IN	AC	TT	IN	AC	TT	IN	AC	TT
Parameter	Unit																		
Alkalinity (as CaCO <sub>3</sub> )	mg/L	-	- -	-	-	-	-	-	-	- -	-	-	-	-	-	-	-	-	-
Ammonia (as N)	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoride	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulfate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate (as N)	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total P (as P)	μg/L	-	-		-	-	-	-	-	-	804	779 -	108	832	821 -	172 -	-	-	-
Silica (as SiO <sub>2</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	S.U.	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>
Temperature	°C	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>
DO	mg/L	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>
ORP	mV	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>
Total Chlorine	mg/L	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>
Total Hardness (as CaCO <sub>3</sub> )	mg/L	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ca Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mg Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
As (total)	μg/L	28.5	18.7	9.4	41.3	41.8	10.7	35.1	36.1	10.3	35.9	35.5 -	7.6	38.6	37.9	10.4	35.2	35.6	5.6
As (soluble)	μg/L	28.3	11.0	7.9	34.5	11.3	9.2	34.3	9.0	7.7	28.8	8.2	6.3	33.8	9.5	7.9	33.9	6.6	5.2
As (particulate)	μg/L	0.2	7.7	1.6	6.7	30.5	1.5	0.8	27.1	2.6	7.0	27.4	1.3	4.9	28.4	2.5	1.3	29.0	0.4
As (III)	μg/L	12.5	1.2	0.8	13.8	1.0	0.9	24.2	0.9	1.2	28.4	1.3	1.1	27.8	1.2	1.2	24.2	0.3	0.2
As (V)	μg/L	15.8	9.8	7.1	20.8	10.3	8.3	10.0	8.2	6.4	0.5	6.9	5.2	6.0	8.2	6.7	9.7	6.4	5.0
Fe (total)	μg/L	2,303	701 -	45.0	8,045	2,229	<25 -	2,445 -	2,520	142 -	2,204	2,717	<25 -	2,274	2,752	104	2,364	3,573	31.9 -
Fe (soluble)	μg/L	2,462	<25	<25	6,314	<25	<25	2,391	<25	<25	<25	<25	<25	2,410	<25	<25	2,307	<25	<25
Mn (total)	μg/L	133	127 -	117	195	108	76.3 -	144 -	138	128 -	134 -	131 -	123	134	133 -	128	140 -	150 -	137
Mn (soluble)	μg/L	142	127	120	198	90.8	76.4	146	127	125	130	122	124	141	129	133	141	140	134

<sup>(</sup>a) Operator did not take water quality measurements. (b) Speciation study sampling began on 01/23/08 for 3 sampling events.

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Table B-1. Analytical Results from Long-Term Sampling at Arnaudville, LA (Continued)

Martinary (see CaCO)	Sampling Date			11/18/08			12/03/08			01/19/09			01/27/09			03/13/09			03/23/09	
Abaninly (as CacCo.)  ngtl	Sampling Location																			
Akadiniy (as CacCo), mg/L	Parameter	Unit	IN	AC	11	IN	AC													
Ammonia (as N) mgl, mgl, mgl, mgl, mgl, mgl, mgl, mgl,	Alkalinity (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
Fluindide mg/L   -	A	"	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	<u> </u>
Sulfate mgl. 1. 0. 1. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.	` '	_		-	-	-	-		-	-	-	-	-	-	-		-	-	-	
Nitrate (as N)		_		-	-	-	-		-	-	-	-	-	-	-		-	-	-	
Total P (as P)    pg/L   726		_		-	-		-		-				-		-				-	
Total P (as P)  Mg/L  Turbidity  MTU  MTU  MG/L	Nitrate (as N)	mg/L				-	-	-	-	-	-	-	-	-	-	-	-	-	-	<u> </u>
Silica (as SiO2)  Mg/L  Turbidity  NTU  NTU  NTU  NTU  NTU  NTU  NTU  NT	Total P (as P)	μg/L	726 -	1,717 -	148		-		-		-			-	-			-	-	-
Turbidity NTU   1.	Silica (as SiO <sub>2</sub> )	mg/L		-	-	-	-		-						-			-	-	-
PH   S.U.   NA <sup>(i)</sup>   N	Turbidity	NTU	-	-	-	-	-		-	-	-		-	-	-			-	-	-
Temperature   C   NA   NA   NA   NA   NA   NA   NA	TOC	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DO mg/L NA(**) NA(***) NA	pH	S.U.	NA <sup>(a)</sup>																	
ORP         mV         NA(*)         NA(*	Temperature	°C	NA <sup>(a)</sup>																	
Total Chlorine	DO	mg/L	NA <sup>(a)</sup>																	
Total Hardness (as CaCO <sub>3</sub> ) mg/L	ORP	mV	NA <sup>(a)</sup>																	
Ca Hardness (as CaCO <sub>3</sub> ) mg/L	Total Chlorine	mg/L	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>															
Mg Hardness (as CaCO <sub>3</sub> )         mg/L         -	Total Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
As (total)    As (total)   As (	Ca Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
As (total) μg/L	Mg Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
As (soluble) μg/L 36.6 14.9 8.5 32.3 2.5 4.7 34.9 10.1 7.2 29.3 10.0 7.7 31.7 3.8 12.6 29.4 11.3 9.2 As (particulate) μg/L 4.2 22.7 2.0 3.9 34.4 7.6 <0.1 22.4 0.2 0.3 20.9 0.2 1.2 30.5 10.2 3.1 22.7 1.9 As (III) μg/L 34.0 0.9 0.9 30.9 0.8 0.8 1.6 0.5 0.7 27.5 0.7 0.7 30.5 0.9 0.9 23.7 0.3 0.4 As (V) μg/L 2.6 13.9 7.6 1.3 1.7 3.9 33.3 9.6 6.5 1.9 9.3 7.0 1.2 2.9 11.8 5.7 10.9 8.8 Fe (total) μg/L 1,983 2,132 135 2,283 9,399 1,399 1,812 2,159 34 1,768 2,159 26 2,317 6,003 1,763 2,052 2,487 146 7.5 Fe (soluble) μg/L 1,960 <25 <25 2,149 26 <25 241 32 <25 1,851 <25 <25 2,228 31.2 <25 1,835 <25 <25 1,835 <25 <25	As (total)	μg/L	40.9	37.6	10.5	36.2			33.0	32.5		29.7			32.9			32.5	34.0	11.1
As (particulate) μg/L 4.2 22.7 2.0 3.9 34.4 7.6 <0.1 22.4 0.2 0.3 20.9 0.2 1.2 30.5 10.2 3.1 22.7 1.9  As (III) μg/L 34.0 0.9 0.9 30.9 0.8 0.8 1.6 0.5 0.7 27.5 0.7 0.7 30.5 0.9 0.9 23.7 0.3 0.4  As (V) μg/L 2.6 13.9 7.6 1.3 1.7 3.9 33.3 9.6 6.5 1.9 9.3 7.0 1.2 2.9 11.8 5.7 10.9 8.8  Fe (total) μg/L 1,983 2,132 135 2,283 9,399 1,399 1,812 2,159 34 1,768 2,159 26 2,317 6,003 1,763 2,052 2,487 146  Fe (soluble) μg/L 1,960 <25 <25 2,149 26 <25 241 32 <25 1,851 <25 <25 2,228 31.2 <25 1,835 <25 <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (25 1,835) <25 (2	As (soluble)	ua/L	36.6	14.9	8.5	32.3	2.5		34.9	10.1		29.3		7.7	31.7	3.8	12.6	29.4	11.3	9.2
As (III) μg/L 34.0 0.9 0.9 30.9 0.8 0.8 1.6 0.5 0.7 27.5 0.7 0.7 30.5 0.9 0.9 23.7 0.3 0.4  As (V) μg/L 2.6 13.9 7.6 1.3 1.7 3.9 33.3 9.6 6.5 1.9 9.3 7.0 1.2 2.9 11.8 5.7 10.9 8.8  Fe (total) μg/L 1,983 2,132 135 2,283 9,399 1,399 1,812 2,159 34 1,768 2,159 26 2,317 6,003 1,763 2,052 2,487 146  Fe (soluble) μg/L 1,960 <25 <25 2,149 26 <25 241 32 <25 1,851 <25 <25 2,228 31.2 <25 1,835 <25 <25  Mn (total) μg/L 1.0 170 156 117 135 109 113 110 105 107 106 99.4 124 135 120 123 122 131	,															1				+
As (V) μg/L 2.6 13.9 7.6 1.3 1.7 3.9 33.3 9.6 6.5 1.9 9.3 7.0 1.2 2.9 11.8 5.7 10.9 8.8  Fe (total) μg/L 1,983 2,132 135 2,283 9,399 1,399 1,812 2,159 34 1,768 2,159 26 2,317 6,003 1,763 2,052 2,487 146  Fe (soluble) μg/L 1,960 <25 <25 2,149 26 <25 241 32 <25 1,851 <25 <25 2,228 31.2 <25 1,835 <25 <25  Mn (total) μg/L 110 170 156 117 135 109 113 110 105 107 106 99.4 124 135 120 123 122 131	,										ļ					<u> </u>				
Fe (total)  μg/L																				
Mn (total)  μg/L  110  170  156  117  135  109  113  110  105  107  106  99.4  124  135  120  123  122  131								1,399			ļ		2,159		-	6,003	1,763		<b> </b>	<b>-</b>
Mn (total)  μg/L  110  170  156  117  135  109  113  110  105  107  106  99.4  124  135  120  123  122  131	Fe (soluble)	μg/L	1,960	<25	<25	2,149	26	<25	241	32	<25	1,851	<25	<25	2,228	31.2	<25	1,835	<25	<25
Mn (soluble)	,		110	170 -	156 -		135		113	110	105	107	106	99.4	124 -	135	120	123	122	131
1711 (OCIONIC)   POPE   101   100   101   110   111   101   100   112   100   114   00.0   101   122   102   110   120   111   120	Mn (soluble)	μg/L	131	155	157	119	117	107	109	112	109	112	98.6	101	122	102	113	126	111	128

<sup>(</sup>a) Operator did not take water quality measurements.

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Table B-1. Analytical Results from Long-Term Sampling at Arnaudville, LA (Continued)

Sampling Date			03/30/09			08/18/09			09/01/09			09/09/09			09/15/09			09/28/09	
Sampling Location																			
Parameter	Unit	IN	AC	TT															
		-	-	-	326	324	315	318	323	316	323	309	305	307	294	302	322	314	308
Alkalinity (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia (as N)	mg/L	-	-	-	1.9	1.7	1.5	1.9	1.6	1.6	1.9	1.3	1.3	1.9	1.4	1.6	2.0	0.9	1.2
Fluoride	mg/L	-	-	-	0.3	0.2	0.7	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
Sulfate	mg/L	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrate (as N)	mg/L	-	-	-	<0.05	<0.05	0.1	<0.05	<0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.1	0.1
Total P (as P)	μg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
, ,		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silica (as SiO <sub>2</sub> )	mg/L	-	-	-	44.4	44.9	44.6	46.4	46.8	47.0	45.8	46.8	47.1	45.1	45.3	45.3	46.5	47.2	47.3
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	-	-	-	32.0	5.9	0.3	29.0	2.3	0.5	32.0	2.0	0.5	31.0	2.3	0.4	32.0	2.0	0.1
TOC	mg/L				1.8	1.4	1.3	1.6	1.6	1.6	1.6	2.4	1.4	1.8	1.7	1.6	1.3	1.4	1.3
pH	S.U.	NA <sup>(a)</sup>																	
Temperature	°C	NA <sup>(a)</sup>																	
DO	mg/L	NA <sup>(a)</sup>																	
ORP	mV	NA <sup>(a)</sup>																	
Total Chlorine	mg/L	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>	_	NA <sup>(a)</sup>	NA <sup>(a)</sup>	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>
Total Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	273	281	275	274	266	255	242	231	225	267	258	256
Ca Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	175	183	179	175	170	160	149	142	138	180	172	172
Mg Hardness (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	98.3	97.8	96.5	99.8	96.0	94.7	92.2	89.2	87.7	86.9	85.5	84.9
A ((   1   1)	,,	32.7	32.0	16.4	30.8	34.1	9.9	30.2	33.6	7.3	28.3	31.5	7.4	29.9	32.4	1.4	32.7	33.8	9.4
As (total)	μg/L	-	-	-	-	-	-	-	-	-	-	-	-	31.5	30.9	-	-	-	-
As (soluble)	μg/L	32.7	32.0	16.4	30.9	11.2	9.3	29.7	11.6	8.9	28.4	10.5	8.5	25.0	2.2	0.3	30.5	10.5	9.6
As (particulate)	μg/L	0.1	17.1	5.1	<0.1	22.9	0.6	0.5	22.0	<0.1	<0.1	20.9	<0.1	4.9	30.2	1.1	2.2	23.3	<0.1
As (III)	μg/L	31.9	8.0	0.9	12.3	1.5	1.3	19.5	0.5	0.3	20.1	0.7	<0.1	20.1	0.9	0.4	26.4	0.5	0.5
As (V)	μg/L	0.8	14.0	10.4	18.5	9.7	8.0	10.2	11.1	8.6	8.4	9.9	8.4	4.9	1.3	<0.1	4.2	10.0	9.1
Fe (total)	μg/L	2,332	2,423	824	1,854	1,892	41	1,838	1,790	<25	1,775	1,704	87	1,805	1,758	69	1,938	1,856	27
. 5 (10101)	rg/∟	-	-	-	-	-	-	-	-	-	-	-	-	2,114	2,067	-	-	-	-
Fe (soluble)	μg/L	2,280	<25	<25	1,904	118	<25	1,966	<25	<25	1,857	<25	<25	1,881	<25	<25	1,958	<25	<25
Mn (total)	μg/L	112	107	77.7	164	113	110	112	112	103	110	107	103	115	114	107	119	116	110
(/	r-3, =	-	-	-	-	-	-	-	-	-	-	-	-	139	134	-	-	-	-
Mn (soluble)	μg/L	112	93.5	97.9	165	107	106	117	96.3	105	113	25.2	111	116	108	107	118	99	116

<sup>(</sup>a) Operator did not take water quality measurements.

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Table B-1. Analytical Results from Long-Term Sampling at Arnaudville, LA (Continued)

Sampling Date			10/05/09			10/13/09			10/19/09			10/26/09			11/03/09			11/09/09	
Sampling Location																			
Parameter	Unit	IN	AC	TT															
		311	309	311	321	308	313	310	308	314	290	297	305	329	325	320	319	326	328
Alkalinity (as CaCO <sub>3</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia (as N)	mg/L	2.1	1.6	1.6	2.0	1.4	1.4	2.0	1.8	1.9	2.0	1.8	1.9	2.0	1.8	1.6	2.0	1.6	1.6
Fluoride	mg/L	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.1
Sulfate	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrate (as N)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	0.1	<0.05	<0.05	<0.05
Total P (as P)	μg/L	-	-	-	706	715	323	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silica (as SiO <sub>2</sub> )	mg/L	44.1	45.0	45.0	42.0	42.6	41.6	41.8	42.6	42.4	45.9	46.6	47.7	44.0	44.3	44.7	47.1	48.5	47.6
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	32.0	2.6	0.9	31.0	2.7	0.5	32.0	2.1	0.7	30.0	2.2	1.0	26.0	2.0	0.9	30.0	2.0	2.1
тос	mg/L	1.0	1.0	1.1	1.0	1.1	<1	<1.0	1.0	<1.0	1.1	1.2	1.1	1.1	1.1	1.3	1.4	1.5	1.4
pН	S.U.	NA <sup>(a)</sup>																	
Temperature	°C	NA <sup>(a)</sup>																	
DO	mg/L	NA <sup>(a)</sup>																	
ORP	mV	NA <sup>(a)</sup>																	
Total Chlorine	mg/L	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>															
Total Hardness (as CaCO <sub>3</sub> )	mg/L	264	253	251	292	277	286	315	307	309	420	417	415	440	438	439	206	206	205
Ca Hardness (as CaCO <sub>3</sub> )	mg/L	177	168	167	192	181	189	231	231	225	302	301	298	316	316	316	108	111	110
Mg Hardness (as CaCO <sub>3</sub> )	mg/L	87.9	84.8	83.8	100	96.0	97.8	84.0	76.2	83.3	118	116	117	124	122	124	97.2	95.1	95.5
As (total)	//	33.8	34.6	18.6	32.4	32.2	14.9	31.0	32.2	10.5	27.2	28.6	10.8	26.4	27.9	10.2	35.4	35.5	12.8
AS (IOIAI)	μg/L	32.1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
As (soluble)	μg/L	11, 11.5	31.0, 31.3	8.8	28.5	9.6	7.1	28.6	15.4, 16.4	8.5	26.5	10.5	8.9	25.8	8.9	9.8	33.9	12.4	9.7
As (particulate)	μg/L	22.7	3.6	9.8	3.9	22.6	7.8	2.4	16.8	1.9	0.7	18.1	1.9	0.6	19.0	0.3	1.5	23.1	3.1
As (III)	μg/L	0.4, 0.7	27.0, 30.2	0.6	26.8	<0.1	<0.1	27.8	<0.1, 0.52	0.3	24.2	0.3	0.1	24.0	<0.1	0.3	32.3	1.2	1.3
As (V)	μg/L	10.6	3.7	8.2	1.7	9.5	7.0	8.0	15.4	8.2	2.3	10.2	8.8	1.9	8.8	9.6	1.5	11.2	8.4
Fe (total)	μg/L	2,054	1,825	790	2,283	2,122	732	2,050	2,305	120	2,005	2,042	191	2,072	2,134	325	2,373	2,411	235
		2,364 <25,	- 1956,	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-
Fe (soluble)	μg/L	25.5	2165	<25	2,203	<25	<25	2,362	<25, <25	<25	2,176	25	<25	2,155	<25	<25	2,452	28.0	<25
Mn (total)	μg/L	119	116	116	119	115	119	134	136	125	108	107	104	111	109	104	150	142	133
,	1 3. –	134	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mn (soluble)	μg/L	104, 119	122, 135	113	119	110	116	138	111, 113	130	114	105	105	115	102	90.8	144	129	135

<sup>(</sup>a) Operator did not take water quality measurements.

Table B-1. Analytical Results from Long-Term Sampling at Arnaudville, LA (Continued)

Sampling Date			11/17/09			12/08/09			01/05/10			01/11/10	
Sampling Location													
Parameter	Unit	IN	AC	TT									
Alkalinity (as CaCO <sub>3</sub> )	mg/L	342	329	324	335	330	326	334	343	350	336	331	340
7 intaininty (do odoos)	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia (as N)	mg/L	1.8	1.5	1.5	1.9	1.7	0.2	2.1	1.8	1.8	1.9	1.9	1.9
Fluoride	mg/L	0.2	0.2	0.2	0.2	0.2	0.8	0.3	0.2	0.3	0.2	0.2	0.2
Sulfate	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrate (as N)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total P (as P)	μg/L	-	-	-	-	-	-	-	- -	-	-	- -	-
		48.3	47.7	47.0	43.5	44.8	45.2	46.7	47.9	48.4	45.0	46.6	46.9
Silica (as SiO <sub>2</sub> )	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
		26.0	1.9	0.4	30.0	1.7	0.8	38.0	2.4	0.3	31.0	3.2	1.4
Turbidity	NTU	-	-	-	-	-	-	-	-	-	-	-	-
TOC	mg/L	1.2	1.2	1.1	1.9	1.1	<1	<1.0	1.1	1.0	1.2	1.1	<1.0
pН	S.U.	NA <sup>(a)</sup>											
Temperature	°C	NA <sup>(a)</sup>											
DO	mg/L	NA <sup>(a)</sup>											
ORP	mV	NA <sup>(a)</sup>											
Total Chlorine	mg/L	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>									
Total Hardness (as CaCO <sub>3</sub> )	mg/L	193	198	187	244	229	222	263	253	246	277	277	278
Ca Hardness (as CaCO <sub>3</sub> )	mg/L	103	106	100	162	153	149	173	168	163	180	190	188
Mg Hardness (as CaCO <sub>3</sub> )	mg/L	89.4	91.4	86.5	82.1	75.8	72.3	90.2	85.0	83.0	96.2	87.3	90.1
As (total)	μg/L	42.4	41.8	13.8	27.9	27.2	3.9	27.7	31.1	18.1	28.3	28.9	14.3
` '		-	-	-	-	-	-	-	-	-	-	-	-
As (soluble)	μg/L	37.7	14.3	12.1	27.9	9.3	3.9	28.1	10.8	9.5	28.1	14.4	14.3
As (particulate)	μg/L	4.7	27.4	1.7	<0.1	17.9	<0.1	<0.1	20.3	8.5	0.2	14.5	<0.1
As (III)	μg/L	35.2	1.6	1.6	24.0	0.6	8.0	28.1	1.2	1.1	27.9	1.1	2.2
As (V)	μg/L	2.5	12.7	10.5	3.8	8.7	3.1	<0.1	9.5	8.5	0.2	13.3	12.1
Fe (total)	μg/L	2,255	2,264	118 -	1,959 -	1,902	52 -	2,939	2,701	1037	2,076	2,154	117 -
Fe (soluble)	μg/L	2,337	<25	<25	1,903	<25	<25	3,276	35	<25	2,238	31	<25
		138	136	117	123	114	99.9	144	132	106	121	116	106
Mn (total)	μg/L	-	-	-			-		-	-		-	-
Mn (soluble)	μg/L	131	116	113	125	114	104	151	124	103	127	115	117

<sup>(</sup>a) Operator did not take water quality measurements.

Table B-1. Analytical Results from Long-Term Sampling at Arnaudville, LA (Continued)

Sampling Date		01/22/10					02/01/10			02/09/10			08/05/10		
Sampling Location															
Parameter	Unit	IN	AC	TA	ТВ	TT	IN	AC	TT	IN	AC	TT	IN	AC	TT
Alkalinity (as CaCO <sub>3</sub> )	mg/L	314 -	325	332	336 -	321 -	316 -	332 -	330 -	343 -	334 -	352 -	318 -	327 -	313 -
Ammonia (as N)	mg/L	2.0	1.9	1.9	1.9	1.9	2.0	1.9	1.9	1.9	1.9	2.0	2.0	1.8	1.8
Fluoride	mg/L	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Sulfate	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrate (as N)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total P (as P)	μg/L	-	-			-	-	-	-	-	-	-	-	-	-
Silica (as SiO <sub>2</sub> )	mg/L	49.3	50.0	50.1	49.6	49.6 -	48.2 -	49.0 -	48.9	45.5 -	46.8	46.4	47.0 -	47.8 -	48.7
Turbidity	NTU	14.0	4.2	0.3	0.6	0.4	31.0	4.9 -	0.4	29.0	4.8	0.6	31.0	33.0	0.4
TOC	mg/L	1.5	1.3	1.3	1.2	1.3	1.5	1.7	1.5	1.7	1.5	1.4	1.6	1.7	1.6
рН	S.U.	NA <sup>(a)</sup>													
Temperature	°C	NA <sup>(a)</sup>													
DO	mg/L	NA <sup>(a)</sup>													
ORP	mV	NA <sup>(a)</sup>													
Total Chlorine	mg/L	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	NA <sup>(a)</sup>	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>	-	NA <sup>(a)</sup>	NA <sup>(a)</sup>
Total Hardness (as CaCO <sub>3</sub> )	mg/L	219	216	214	222	224	211	226	226	275	272	282	100	93.9	93.5
Ca Hardness (as CaCO <sub>3</sub> )	mg/L	130	129	128	133	134	128	141	143	181	182	189	1.8	2.1	0.4
Mg Hardness (as CaCO <sub>3</sub> )	mg/L	88.8	87.5	86.2	89.0	90.6	82.3	84.5	83.4	93.7	89.5	92.3	98.6	91.8	93.2
As (total)	μg/L	27.0	29.6	9.4	10.9	5.2	25.1 -	27.9	12.4	29.5	30.7	12.4	31.9	32.9	6.7
As (soluble)	μg/L	27.8	13.3	9.6	9.8	9.3	26.2	13.3	12.1	29.8	13.3	11.1	33.0	11.8	7.2
As (particulate)	μg/L	<0.1	16.3	<0.1	1.1	<0.1	<0.1	14.5	0.3	<0.1	17.5	1.3	<0.1	21.1	<0.1
As (III)	μg/L	27.3	1.8	1.5	1.4	5.6	25.4	2.0	1.8	29.0	1.1	1.0	31.2	0.3	0.2
As (V)	μg/L	0.5	11.4	8.0	8.4	3.7	0.7	11.4	10.3	0.8	12.1	10.2	1.8	11.5	7.0
Fe (total)	μg/L	2,386	2,273	60 -	124 -	83	2,245 -	2,271	51 -	2,270	2,219	192 -	2,455 -	2,573	<25 -
Fe (soluble)	μg/L	2,403	72	<25	<25	<25	2,322	111	<25	2,404	25	<25	2,485	<25	<25
Mn (total)	μg/L	143 -	138 -	132 -	124 -	132 -	157 -	149 -	137 -	133 -	134 -	128 -	150 -	224	156 -
Mn (soluble)	μg/L	149	136	135	136	137	156	143	140	144	131	130	151	254	156